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Moored Current and Hydrographic Measurements from the Georges Bank Frontal Study, 1988-89

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Canadian Data Report Of Hydrography and Ocean Sciences

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FROM THE GEORGES BANK FRONTAL STUDY, 1988-89

by

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A large number of individuals at the Bedford Institute of Oceanography contributed to the successful execution of the moored measurement component of the field study. Special thanks are due to: Neil Oakey who served as chief scientist on the two principal cruises; Ken Drinkwater who led the 1989 field program; the members of the PCS Current Meter Shop; and the members of the PCS Data Shop. We also thank all of the scientific staff and the ship's officers and crew of Dawson cruises 88017, 88023 and 88036 and Lady Hammond cruise 202 for their valuable contributions to the study.

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ABSTRACT

Loder, J.W. and R.G. Pettipas. 1991. Moored current and hydrographic measurements from the Georges Bank Frontal Study, 1988-89. Can. Data Rep. Hydrogr. Ocean Sci. No. 94: iv + 139 pp.

The moored measurement program of the 1988-89 Georges Bank Frontal Study is described. Current and hydrographic measurements taken with Aanderaa current meters at twenty-five different positions at six sites on northeastern Georges Bank are presented. The observation times are June-July 1988 for two sites, June-October 1988 for three sites, and June-October 1988 and July 1989 for the other site. The presentation consists of summaries of data processing and data return, statistical summaries of the observations by month and entire record for each position, time series plots of the data sampled at 1 hr and 6 hr (low-pass filtered), progressive vector plots, stick plots of the 6-hr data, and tidal analysis results.

RÉSUMÉ

Loder, J.W. and R.G. Pettipas. 1991. Moored current and hydrographic measurements from the Georges Bank Frontal Study, 1988-89. Can. Data Rep. Hydrogr. Ocean Sci. No. 94: iv + 139 pp.

Le programme de mesures effectuées à l'aide de courantomètres amarrés dans le cadre de l'Étude frontale du banc de Georges 1988-89 est décrit. Les mesures effectuées au moyen de courantomètres Aanderaa et des mesures hydrographiques effectuées en vingt-cinq positions et en six emplacements dans la partie nord-est du banc de Georges sont présentées. En deux des emplacements les observations ont été effectuées en juin et juillet 1988, en trois des emplacements elles ont été faites de juin à octobre 1988 et au dernier emplacement de juin à octobre 1988 ainsi qu'en juillet 1989. La présentation consiste en résumés du traitement des données et des résultats, en résumés statistiques mensuels des observations et en enregistrements complets pour chaque position, en tracés de successions chronologiques des données échantillonnées à des intervalles de une heure et de six heures (filtrage passe-bas), en tracés vectoriels progressifs, en histogrammes pour les données à intervalles de six heures et en résultats de l'analyse tidale.

INTRODUCTION

During the periods June - October 1988 and July 1989, the Department of Fisheries and Oceans conducted a field study into a number of aspects of the physics and biology of the tidal front on northeastern Georges Bank. Referred to as the Georges Bank Frontal Study, the study included moored measurements, current and hydrographic surveys, turbulence profiles, drifter tracking, primary production measurements, and zooplankton and larval fish distribution surveys.

The observational strategy was designed around moored current and hydrographic measurements at six sites (Fig. 1): four bracketing the historical position of the front on a "western" line along $66^{\circ}48'W$, and two on a second "eastern" line along $66^{\circ}30'W$. This report presents a graphical and statistical description of the observations from the principal moored instruments, Aanderaa current meters (henceforth RCMs) deployed at twenty-five different positions at these sites. The report starts with short sections on the moored measurement program and data processing. The main section follows, displaying the results for the various positions. Other moored measurements are briefly noted but, due to problems with those instruments, this presentation is limited to observations from the RCMs.

For further background on operational aspects of the mooring program, the reader is referred to the cruise reports (Loder 1988; Oakey 1988a,b) for the deployment (Dawson 88017 and 88023) and recovery (Dawson 88036) cruises. For further background on the RCM measurements, including a rate degradation problem caused by mooring vibration, see Loder and Hamilton (1990) and Loder et al. (1990).

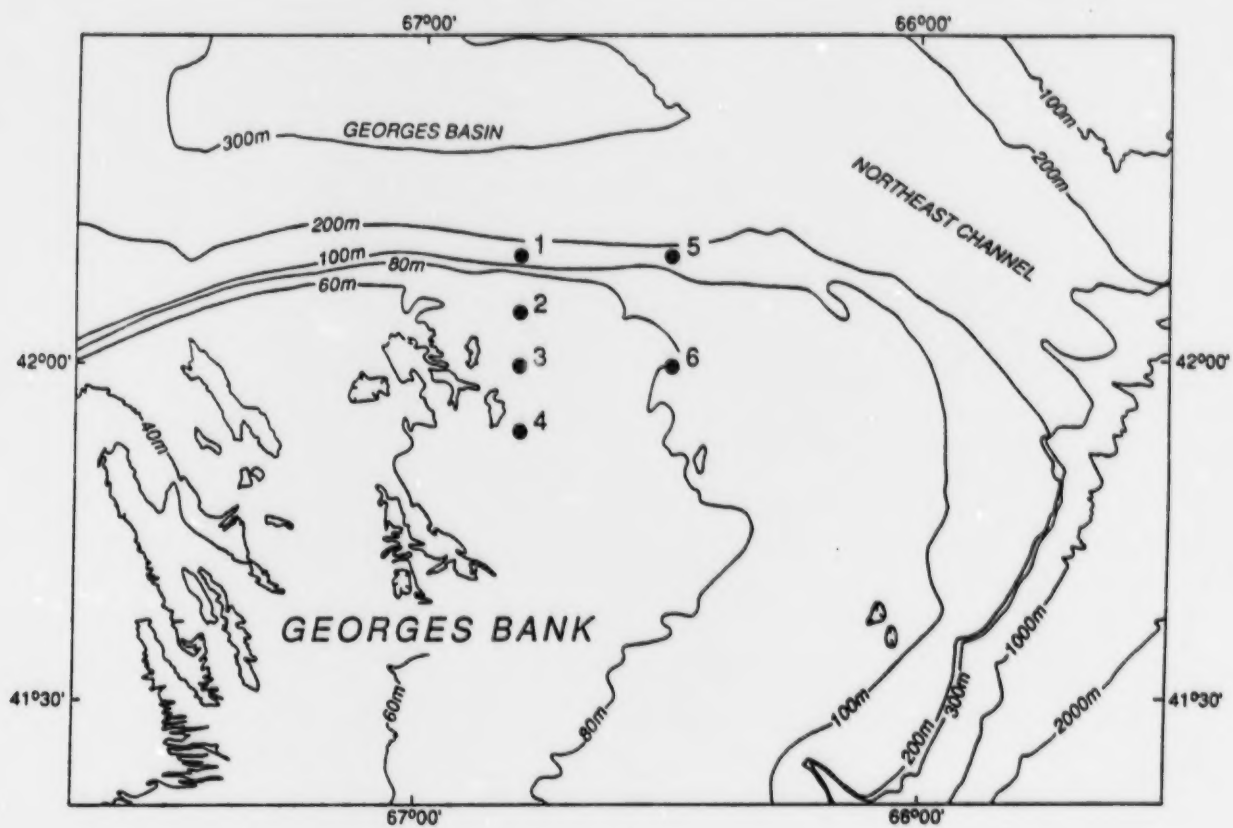


Figure 1. Location map for northeastern Georges Bank showing mooring sites (solid circles) and bathymetry (in m).

MOORED MEASUREMENT PROGRAM

Moorings

Information on the moorings deployed during the Georges Bank Frontal Study is summarized in Table 1.

In late June 1988 (cruise 88023), subsurface moorings with RCMs were placed at each of the six sites. Because of intense fishing pressure, moorings 896 and 897 at sites 5 and 6 respectively were recovered about two weeks later (on 88023) and not replaced. Shortly thereafter, moorings 891 and 893 at sites 2 and 3 respectively were recovered and replaced by moorings 912 and 913. Replacement mooring 913 at site 3 and moorings 889 and 895 at sites 1 and 4 respectively were left in place until the end of the 1988 study period in mid-October (cruise 88036). Replacement mooring 912 at site 2 was recovered and replaced by mooring 919 at the start of the fall cruise (88036), because its upper current meter had broken loose in late August (the meter was subsequently recovered by a fishing vessel). In all, moorings with RCMs were maintained from late June to mid-October at sites 1 to 4, and for two weeks in June-July at sites 5 and 6. All current meters were recovered, although there were data quality problems in some cases (see below).

In July 1989 (Lady Hammond cruise 202), a single mooring with three RCMs, as well as two S4 electromagnetic current meters, was deployed for about two weeks at site 3 during further drifter and larval fish distribution studies.

Other moored measurement programs (Table 1; Fig. 2) were conducted with mixed success. A 150-kHz RD Instruments acoustic Doppler current profiler (ADCP) was bottom-mounted at site 3 (mooring 920) from early June to mid-July 1988 as part of its engineering trials. It returned six-week time series of velocity at twenty-six vertical levels, but there were data quality problems (see Belliveau and Loder 1990 and Loder et al. 1990 for more details). Fast-response Sea Data thermistor chains were deployed for about two weeks at sites 1 and 2 in June-July (moorings 890 and 892) and at site 2 in September-October (mooring 918). There were also quality problems with the data from these instruments, although portions were useful after editing. A MiniMet meteorological buoy yielded little useful data during three deployment attempts at site 3 in June-July 1988, as a result of instrument malfunction. Data obtained

Table 1. Summary of positions, water depths, and deployment and recovery times (UTC) and dates (day/month) for moorings in the Georges Bank Frontal Study. BIO No. refers to the BIO Consecutive Mooring Number. The sites are shown in Figure 1. RCMs refer to Aanderaa current meters, T Chain to a Sea Data thermistor chain, Met Buoy to a MiniMet meteorological buoy, and ADCP to a RD Instruments acoustic Doppler current profiler.

BIO No.	Site	Depth (m)	Position Lat(N) Long(W)	Deployment Time/Date	Recovery Time/Date	Remarks
<u>1988</u>						
889	1	155	42°10.0' 66°47.9'	1532/26/06	1755/14/10	RCMs
890	1	144	42°09.9' 66°48.1'	1620/26/06	1820/11/07	T Chain
891	2	67	42°04.8' 66°48.1'	1921/27/06	1451/11/07	RCMs
912	2	67	42°04.8' 66°48.1'	1655/11/07	1247/30/09	Replaced 891
919	2	66	42°04.7' 66°47.9'	1552/30/09	1902/15/10	Replaced 912
892	2	66	42°04.8' 66°47.9'	2041/27/06	1358/11/07	T Chain
918	2	67	42°04.9' 66°48.0'	1613/30/09	1932/15/10	Replaced 892
893	3	67	41°59.8' 66°47.9'	1838/25/06	2018/11/07	RCMs
913	3	67	41°59.8' 66°48.0'	2159/11/07	1433/15/10	Replaced 893
920	3	68	41°59.6' 66°47.9'	1113/01/06	1633/13/07	ADCP mooring
894A	3	67	41°59.7' 66°47.7'	1952/25/06	0030/26/06	Met Buoy
894B	"	66	41°59.9' 66°47.7'	1611/28/06	2104/29/06	" "
894C	"	67	41°59.9' 66°47.8'	1835/07/07	2217/11/07	" "
895	4	63	41°53.7' 66°47.8'	1610/27/06	1328/14/10	RCMs
896	5	148	42°09.1' 66°29.7'	1043/27/06	1630/09/07	RCMs
897	6	83	41°58.6' 66°30.2'	1326/27/06	2048/09/07	RCMs
<u>1989</u>						
955	3	70	41°59.9' 66°48.0'	2255/13/07	1323/30/07	RCMs and S4s

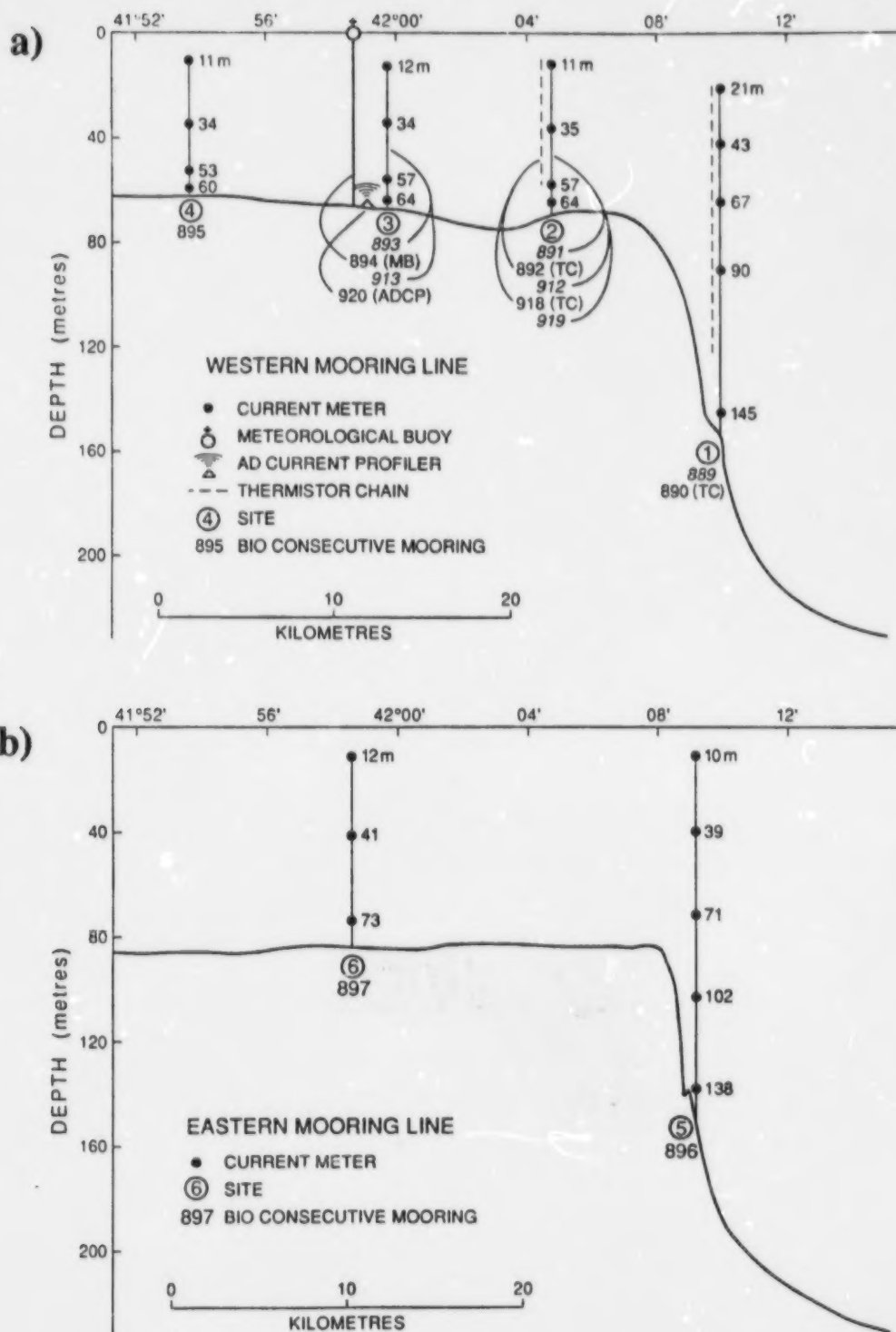


Figure 2. Cross-bank sections on the a) western and b) eastern mooring lines showing instrument positions. The solid circles indicate the Aanderaa current meters, with the adjacent number being the depth (in m) below the sea surface.

from these instruments are not included in this report.

Instruments

Information on the RCMs used in the study is summarized in Figure 2 and Table 2. Meters were positioned at nominal depths of 10 m below surface, mid-depth, and 10 m above bottom (mab) at each site (note that the actual instrument depths varied depending on the water depth as well as mooring motion). In addition, meters were placed at 3 mab at sites 2 - 4 in 1988, and at other intermediate depths at sites 1 and 5. All of the meters used modified paddle-wheel rotors designed to reduce overspeeding in the surface wave zone. Most of the meters were non-vector-averaging models (RCM5s), although vector-averaging models (RCM7/8s) were used in some cases. The recording interval was generally set at 30 minutes, but was reduced for shorter deployments. All instruments had temperature sensors, most had conductivity cells, and some had pressure sensors. Instantaneous values of these variables near the end of each recording interval were sampled. For further details on the RCMs and their Georges Bank deployment, the reader is referred to the manufacturers' manuals (Aanderaa 1979, 1987) and Loder et al. (1990).

In 1989 two InterOcean S4 electromagnetic current meters were added to mooring 955 at site 3 for comparison with the upper and mid-depth RCM measurements. The comparison indicated consistent direction measurements, relatively-high (3-9%) rate measurements by the upper RCM, and intermittent clipping of the mid-depth S4 rates (Loder et al. 1990). Since the reliable S4 measurements are largely redundant of the concurrent RCM measurements, they are not included in this presentation.

Data Return

Information on the data return is provided in Tables 2 and 3. In Table 2, the data return periods are shown for each deployed instrument, with cases of partial data return for particular variables indicated (except for pressure). In Table 3, the data return is summarized by position (i.e. site and depth) for current, temperature and salinity. The pressure data were generally of poor quality and are not discussed further in this report.

Table 2. Summary of instrument depths (below mean surface), types, sensors, recording intervals and data return periods (hr UTC/dy/mo) for moored Aanderaa current meter measurements during the Georges Bank Frontal Study. See Table 1 for positions and water depths. For Sensors: R = Rate; D = Direction; T = Temperature; C = Conductivity; and P = Pressure. For some sensors, there was incomplete or nil data return in the indicated return period.

BIO No.	Depth (m)	Instrument Type Sensors	Interval (min)	Data Return Period	Remarks
<u>1988</u>					
889	21	RCM5 R,D,T,C,P	30	1600/26/6-1630/14/10	
"	43	RCM5 R,D,T,C,P	30	1530/26/6-1730/14/10	Partial T,C
"	67	RCM7 R,D,T,C	30	1530/26/6-1730/14/10	All R bad
"	90	RCM5 R,D,T	30	1530/26/6-1730/14/10	All R bad after 11/7
"	145	RCM7 R,D,T,C	30	1530/26/6-1730/14/10	
891	11	RCM5 R,D,T,C,P	30	1930/27/6-1430/11/7	
"	35	RCM5 R,D,T,C,P	30	1930/27/6-1430/11/7	
"	57	RCM5 R,D,T,C	30	1930/27/6-1430/11/7	
"	64	RCM5 R,D,T	30	1930/27/6-1430/11/7	
893	12	RCM5 R,D,T,C,P	30	1830/25/6-2000/11/7	
"	34	RCM5 R,D,T,C,P	30	1830/25/6-2000/11/7	
"	57	RCM5 R,D,T,C	30	1830/25/6-2000/11/7	
"	64	RCM5 R,D,T	30	1830/25/6-2000/11/7	
895	11	RCM5 R,D,T,C,P	30	1630/27/6-1300/14/10	All C bad after 6/9
"	34	RCM5 R,D,T	30	1630/27/6-1300/14/10	
"	53	RCM5 R,D,T	30	1630/27/6-1300/14/10	
"	60	RCM5 R,D,T	30	1630/27/6-1300/14/10	All R bad
896	10	RCM5 R,D,T,C,P	30	1100/27/6-1530/9/7	Partial R
"	39	RCM5 R,D,T	30	1100/27/6-1600/9/7	
"	71	RCM5 R,D,T,C,P	30	1100/27/6-1600/9/7	
"	102	RCM5 R,D,T	30	1100/27/6-1600/9/7	
"	138	RCM7 R,D,T,C	30	1100/27/6-1600/9/7	
897	10	RCM5 R,D,T,C,P	30	1330/27/6-2000/9/7	
"	41	RCM5 R,D,T,C,P	30	1330/27/6-2000/9/7	
"	73	RCM7 R,D,T,C	30	1330/27/6-2000/9/7	

Table 2. (continued)

BIO No.	Depth (m)	Instrument Type Sensors	Interval (min)	Data Return Period	Remarks
<u>1988</u>					
912	11	RCM5 R,D,T,C,P	30	1700/11/7-0730/29/8	Instr broke loose
"	35	RCM5 R,D,T,C,P	30	1700/11/7-1230/30/9	
"	57	RCM5 R,D,T,C,P	30	1700/11/7-1230/30/9	
"	64	RCM5 R,D,T	30	1700/11/7-1230/30/9	
913	12	RCM5 R,D,T,C,P	30	2200/11/7-1430/15/10	Partial R
"	34	RCM5 R,D,T,C,P	30	2200/11/7-1430/15/10	
"	57	RCM5 R,D,T,C	30	2200/11/7-0500/19/8	Partial R,T,C
"	64	RCM5 R,D,T	30	2200/11/7-1430/15/10	
919	10	RCM7 R,D,T,C	2.5	NIL	Battery failure
"	34	RCM8 R,D,T,C	2.5	1558/30/9-1730/15/10	All C bad
"	56	RCM7 R,D,T,C	5	1600/30/9-1850/15/10	
"	63	RCM8 R,D,T,C	5	1600/30/9-1900/15/10	
<u>1989</u>					
955	13	RCM5 R,D,T,C	5	2255/13/7-1320/30/7	
"	36	RCM5 R,D,T,C	5	2255/13/7-1320/30/7	
"	60	RCM5 R,D,T,C	5	2255/13/7-1320/30/7	

Table 3. Summary of RCM data return for currents, temperature and salinity by site and position. Site and position are indicated by a 2-digit header: 1-21m refers to site 1 at 21 m. Solid line indicates full return, and dashed line partial return.

Site-Depth	June	July	August	September	October
1988:					
1-21m					
Current					
Temperature					
Salinity					
1-43m					
Current					
Temperature					
Salinity					
1-67m					
Temperature					
Salinity					
1-90m					
Current					
Temperature					
1-145m					
Current					
Temperature					
Salinity					
2-11m					
Current					
Temperature					
Salinity					
2-35m					
Current					
Temperature					
Salinity					
2-57m					
Current					
Temperature					
Salinity					
2-64m					
Current					
Temperature					
	June	July	August	September	October

Table 3. (continued)

	June	July	August	September	October
1988:					
3-12m					
Current		-----			
Temperature					
Salinity					
3-34m					
Current					
Temperature					
Salinity					
3-57m					
Current		-----			
Temperature			--		
Salinity			--		
3-64m					
Current					
Temperature					
4-11m					
Current					
Temperature					
Salinity					
4-34m					
Current					
Temperature					
4-53m					
Current					
Temperature					
4-60m					
Temperature					
5-10m					
Current		-----			
Temperature					
Salinity					
5-39m					
Current					
Temperature					
5-71m					
Current					
Temperature					
Salinity					
	June	July	August	September	October

Table 3. (continued)

	June	July	August	September	October
1988:					
5-102m					
Current	_____				
Temperature	_____				
5-138m					
Current	_____				
Temperature	_____				
Salinity	_____				
6-10m					
Current	_____				
Temperature	_____				
Salinity	_____				
6-41m					
Current	_____				
Temperature	_____				
6-73m					
Current	_____				
Temperature	_____				
Salinity	_____				
1989:					
3-13m					
Current		_____			
Temperature		_____			
Salinity		_____			
3-36m					
Current		_____			
Temperature		_____			
Salinity		_____			
3-60m					
Current		_____			
Temperature		_____			
Salinity		_____			
	June	July	August	September	October

DATA PROCESSING

Currents

Initial processing of the RCM rate and direction records followed the standard procedure at the Bedford Institute of Oceanography. Editing and deletion of suspect data were carried out as described in Loder et al. (1990). In addition, a considerable number of direction spikes (probably arising from instrument swings and the instantaneous sampling) were removed from the original (unaveraged) data from 21 and 43 m at mooring 889 and replaced by linear interpolation.

The RCM velocity data were compared to data from the bottom-mounted ADCP at site 3, and to velocity profiles from a ship-mounted 300-kHz Ametek Straza ADCP (henceforth the Ametek) obtained during anchor stations near most of the 1988 moorings. A major conclusion of the intercomparison (Loder and Hamilton 1990; Loder et al. 1990) was that the RCM rate measurements at the mid-depth and 10 mab positions on the Bank-plateau moorings (sites 2-4, 6) were low by as much as 20%, probably because of mooring vibration. This is illustrated in Figure 3 which shows statistics of the ratio of RCM rate to Ametek rate for various positions and moorings. Rate discrepancies which are consistent among the different moorings are apparent at mid-depth and 10 mab.

Considering the consistency among moorings, a composite "rate re-calibration curve" was determined for each of the mid-depth and 10 mab positions, using data from the 1988 Bank-plateau moorings (displayed in Figs. 12, 17, 20, 22, 24 and 25 of Loder et al. 1990). These data are shown in scatterplot form in Figure 4, where data from 10 mab at mooring 919 have not been included (due to apparent increased near-bottom degradation of the Ametek data.) Various linear and nonlinear regression relations were explored as best fits of the data and other relevant information such as expected zero intercepts.

For the mid-depth position where a nonlinear relation is apparent (Figs. 3, 4), the regression relation $y = ax + bx^2$ was chosen for RCM rate (y) versus Ametek rate (x). Coefficients a and b were evaluated using the BMDP (1983) software package, with a standard deviation between observed and predicted values of 0.07 m/s. Because the RCM rates in the concurrent RCM/Ametek data set were not as high as at other times in some of the RCM records, the regression relation was only used for observed

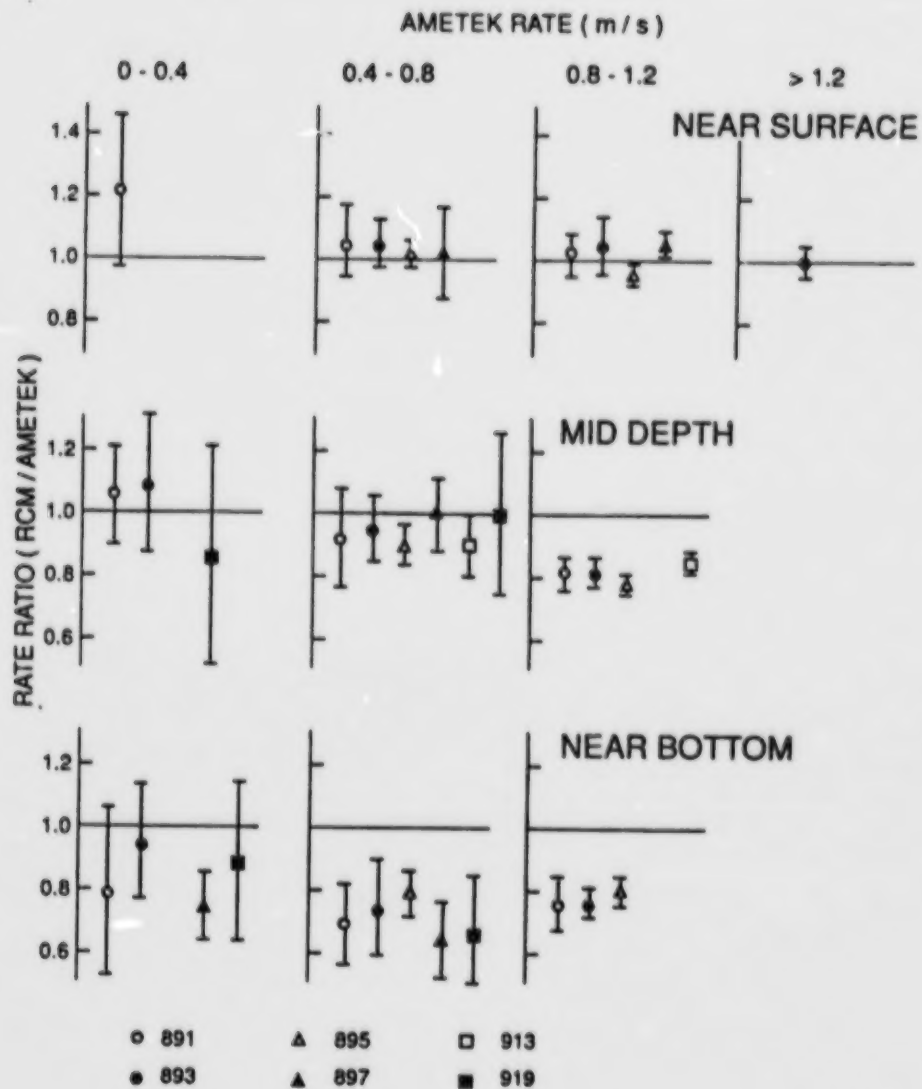


Figure 3. Means and standard deviations of the ratio of RCM rate to Ametek rate in four Ametek rate intervals, for the six 1988 RCM moorings (on the Bank plateau) with concurrent Ametek data. The statistics are grouped by vertical level, and are only shown for cases with 5 or more observations. Near Surface refers to nominal depth of 10 m below surface, and Near Bottom to 10 mab.

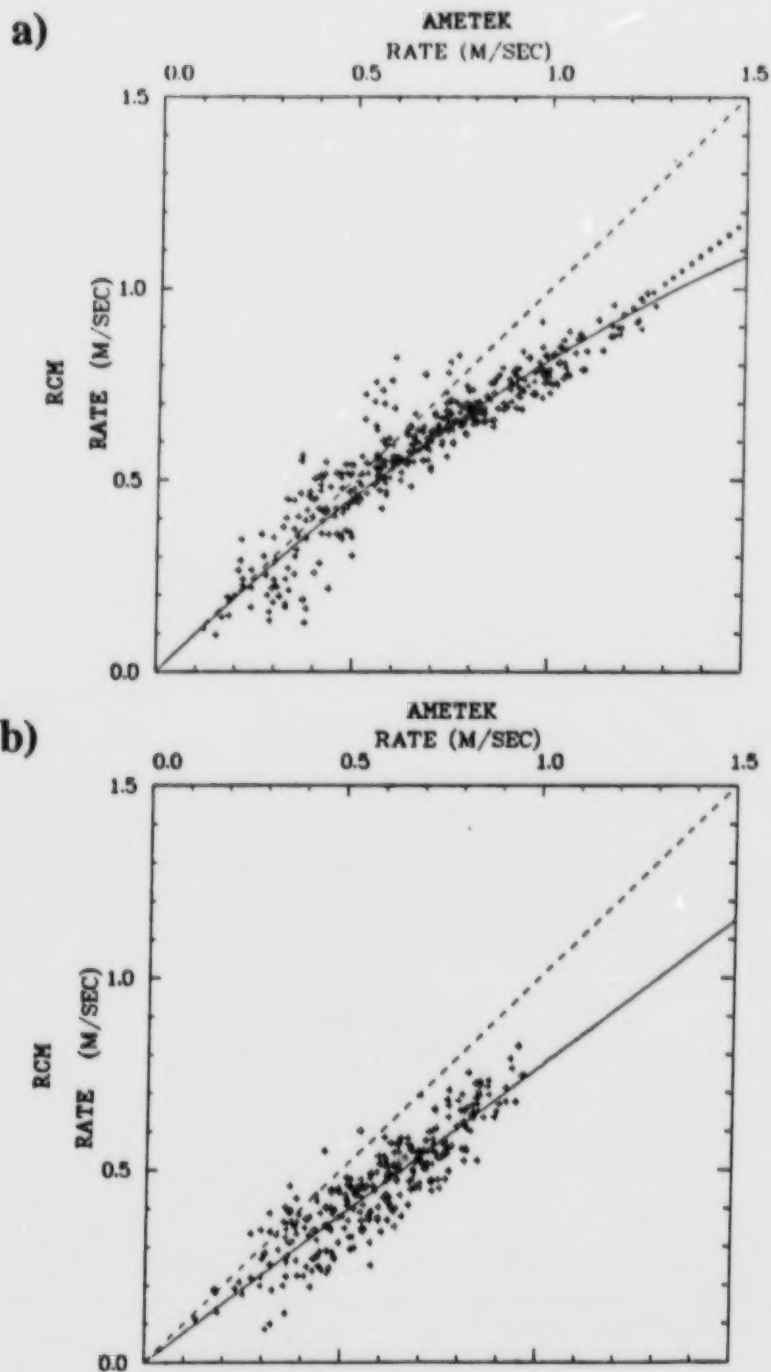


Figure 4. Scatterplots of RCM rate versus Ametek rate for a) mid-depth and b) 10 mab positions on the Bank plateau in 1988. The mid-depth plot includes data from moorings 891, 893, 895, 897, 913 and 919. The 10 mab plot includes data from moorings 891, 893, 895 and 897. The dashed line is the 1:1 line, and the solid line is the regression line described in the text. In a), the dotted line is the constant ratio used as the re-calibration curve for RCM values exceeding 0.92 m/s.

RCM rates between 0 and 0.92 m/s which included 99% of values during Ametek sampling. For higher RCM rates, the rate ratio ($y/x = 0.784$) predicted by the regression relation for $y = 0.92$ m/s was used (essentially, a more conservative correction for values outside the range on which the regression relation is based). Thus, the mid-depth RCM records were re-calibrated using the relations

$$R_c = 2.709 (1 - (1 - 0.738 R)^{1/2}) \quad \text{for } R \leq 0.92 \text{ m/s}$$

$$R_c = 1.276 R \quad \text{for } R > 0.92 \text{ m/s,}$$

where R_c is the corrected value and R the observed RCM value.

For the 10 mab position, the best fit was obtained with a linear relation of the form $y = ax$ (and without data from mooring 919), with a standard deviation between observed and predicted values of 0.07 m/s. Thus, the 10 mab RCM records (including mooring 919) were re-calibrated using the relation $R_c = 1.306 R$ for all R . Due to sidelobe reflection contamination of the near-bottom Ametek data, the Ametek data used in the re-calibration were generally from slightly shallower (1-2 m) depths than 10 mab (see Table 3 of Loder et al. 1990 for actual depths). This depth difference is not accounted for in the present presentation (i.e. the 10 mab currents may be more appropriate to 11 or 12 mab in some cases), since it is comparable to other depth uncertainties associated with the RCM and ADCP measurements.

Upon correction of the appropriate RCM rate records, east (u) and north (v) velocity components were computed.

Temperature, Salinity and Density

Initial processing of the temperature (T) and conductivity (C) records also followed standard procedures at the Bedford Institute. In most cases, no further editing was done on T , and salinity (S) was computed using a fixed pressure. Suspect portions (based on visual inspection) of the T and computed S records were deleted. As a result of considerable spikiness in the S records from the upper level (presumably arising from the different response times of the T and C sensors and the different times of the sampling, in combination with high-frequency internal-wave induced fluctuations in the pycnocline), the S records were

further edited using the range checking and spike removal options in the standard software. Through comparison of the edited S records with several CTD profiles (where available) taken near each mooring, S offsets were determined for each record and applied in cases where the mean offset exceeded the standard deviation.

Finally, the edited T and S records were used to compute density as sigma theta (σ_θ).

Data Merger and Filtering

The above editing yielded final versions of the records for each instrument at the original recording interval. To allow standard plotting and statistical analyses, and the merger of multiple records from sites 2 and 3, the following procedure was followed:

- (1) Data gaps of up to 2 hours duration were eliminated using linear interpolation.
- (2) A box-car filter (e.g. 3-point for 30-min records) was run on the interpolated records of u, v, T, S and σ_θ with subsequent decimation to 1-hr sampling.
- (3) For sites 2 and 3 where there were multiple deployments, the 1-hr time series were joined and the intervening gaps were filled using tidal prediction (harmonics plus mean) and an additional time-dependent (linear) correction based on the difference between the predicted and observed values for the start of the second record.

The resulting records constitute the principal 1-hr data set used in the present report. It may be noted that the data unions are apparent in some cases, particularly for salinity (e.g. site 2 - 57 m and site 3 - 34 and 57 m) indicating that the applied offsets were inadequate. However, the associated uncertainties (ca. 0.2) are generally small compared to the signals of interest.

Finally, for use in examining subtidal variability, the merged 1-hr records of u, v, T, S and σ_θ were low-pass filtered using a 129-point Cartwright filter and then subsampled at 6 hr. The filter passed more than 95% of the input power for periods greater than 40 hr, 50% at 31 hr, and less than 1% at periods less than 24 hr. The resulting 6-hr records constitute the second principal data set of the present report.

DATA PRESENTATION DESCRIPTION

The statistical and graphical data displays are presented in two sections.

The primary section, Statistical and Graphical Summaries, is a four-page presentation for each position (e.g. site 1 at 21 m). The first page for each position has statistical summaries for the entire record and each month. The summaries consist of the number of 1-hr samples, the mean value, the standard deviation (Σ_1) of the 1-hr time series and the standard deviation (Σ_6) of the low-passed time series for each of u , v , T , S and σ_θ . The second and third pages comprise time series plots, with 1-hr time series of rate (speed), u , v , T and S shown on the second page, and 6-hr time series of u , v , T , S and σ_θ shown on the third. There are two graphical displays of the velocity time series on the fourth page for each position: a large panel with a progressive vector plot of the 1-hr data (labelled with calendar days), and a lower panel with a stick plot of the 6-hr velocity vectors. Note that the orientation of north is rotated by 90° between these panels to facilitate legibility of the stick plots. Due to significant gaps in the 1-hr data, low-passed velocity time series are not included for site 5 at 10 m, and beyond days 193 and 197 for site 3 at 12 and 57 m, respectively.

The second section, Tidal Analysis Results, consists of a series of tables with the results of harmonic tidal analysis of the 1-hr velocity records. Results are given for the constituents K_1 , O_1 , M_2 , S_2 , N_2 , M_f , M_4 and MS_4 , from a general tidal analysis on the longest record possible. The tables are in the same order as the positions in the primary section (and in Table 2).

In all of the data presentation, the positive u velocity component is east and the positive v component north. Common variable and time scales are used where practical to facilitate intercomparison of the plots from various sites.

REFERENCES

- Aanderaa Instruments. 1979. Operating Manual. Recording Current Meter Models 4&5. Technical Description No. 119. Bergen, Norway.
- Aanderaa Instruments. 1987. Operating Manual. Recording Current Meters Models 7&8. Technical Description No. 159. Bergen, Norway.
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- Loder, J.W. 1988. Cruise Report 88-017. CSS Dawson, 31 May - 3 June 1988, Northeastern Georges Bank. BIO internal Report. 20 p.
- Loder, J.W. and J.M. Hamilton. 1990. Degradation of paddle-wheel Aanderaa current measurements by mooring vibration in a strong tidal flow. Proc. Fourth IEEE Working Conference on Current Measurement, 107-119.
- Loder, J.W., R.G. Pettipas and D.J. Belliveau. 1990. Intercomparison of current measurements from the Georges Bank Frontal Study. Can. Tech. Rep. Hydrogr. Ocean Sci. No. 127: vi + 75 p.
- Oakey, N.S. 1988a. Cruise Report 88-023. CSS Dawson, 23 June - 15 July 1988, Georges Bank. BIO Internal Report. 50 p.
- Oakey, N.S. 1988b. Cruise Report 88-036. CSS Dawson, 29 September - 18 October 1988, Georges Bank. BIO Internal Report. 42 p.

STATISTICAL AND GRAPHICAL SUMMARIES
BY SITE AND POSITION

THERE ARE FOUR PAGES FOR EACH POSITION WITH:

STATISTICS ON FIRST PAGE

TIME SERIES PLOTS OF 1-HR DATA ON SECOND PAGE

TIME SERIES PLOTS OF 6-HR DATA ON THIRD PAGE

PROGRESSIVE VECTOR AND STICK PLOTS ON FOURTH PAGE

STATISTICS

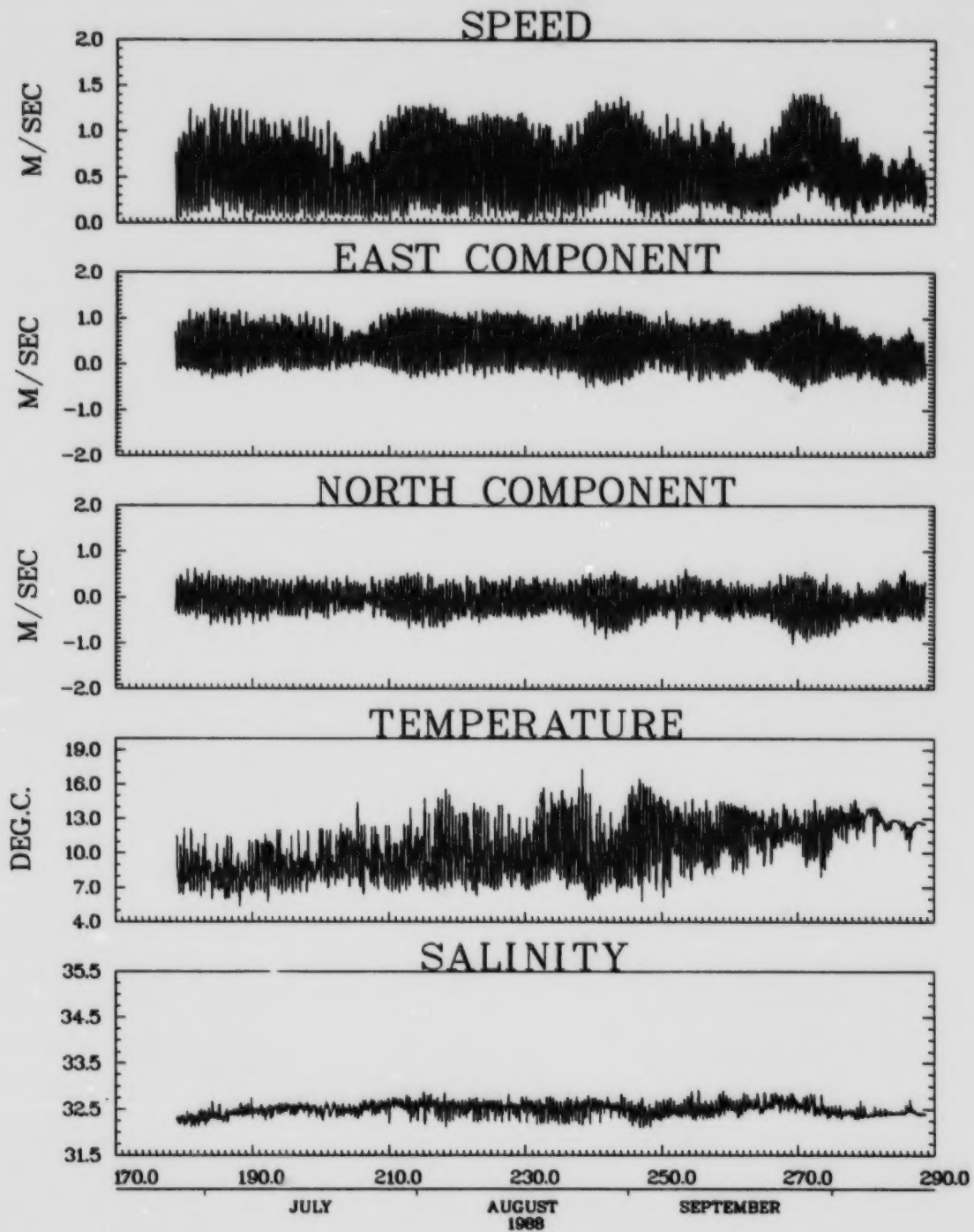
Site 1 at 21 m, 1988

(Mooring 889)

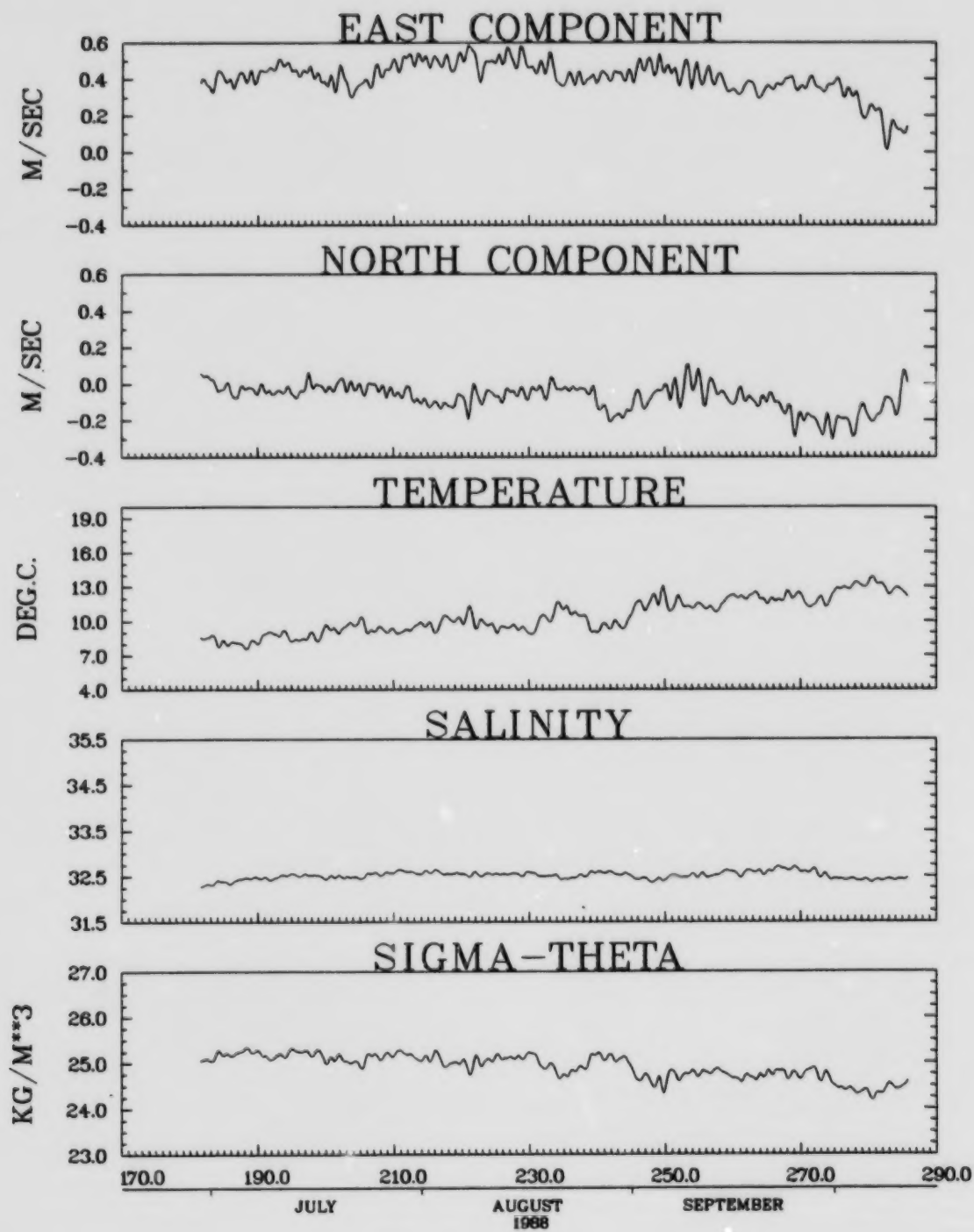
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2639	103	744	744	720	328
$\bar{X}$	0.399	0.386	0.429	0.463	0.393	0.201
Σ_1	0.430	0.425	0.404	0.457	0.434	0.358
Σ_6	0.092	0.018	0.054	0.058	0.056	0.104
North Velocity Component (m.s^{-1})						
N	2639	103	744	744	720	328
$\bar{X}$	-0.071	0.026	-0.029	-0.077	-0.093	-0.133
Σ_1	0.313	0.308	0.291	0.320	0.330	0.287
Σ_6	0.073	0.009	0.030	0.055	0.083	0.083
Temperature ($^{\circ}\text{C}$)						
N	2633	97	744	744	720	328
$\bar{X}$	10.41	8.52	8.86	9.90	11.71	12.83
Σ_1	2.29	1.40	1.50	2.22	1.91	0.72
Σ_6	1.53	0.06	0.61	0.66	0.50	0.39
Salinity (PSS78)						
N	2633	97	744	744	720	328
$\bar{X}$	32.50	32.29	32.50	32.54	32.54	32.42
Σ_1	0.14	0.07	0.11	0.14	0.15	0.06
Σ_6	0.08	0.02	0.07	0.04	0.08	0.02
Sigma-theta (kg.m^{-3})						
N	2633	97	744	744	720	328
$\bar{X}$	24.90	25.06	25.17	25.02	24.71	24.43
Σ_1	0.46	0.25	0.28	0.49	0.43	0.18
Σ_6	0.27	0.02	0.10	0.14	0.11	0.09

N: number of samples in statistics

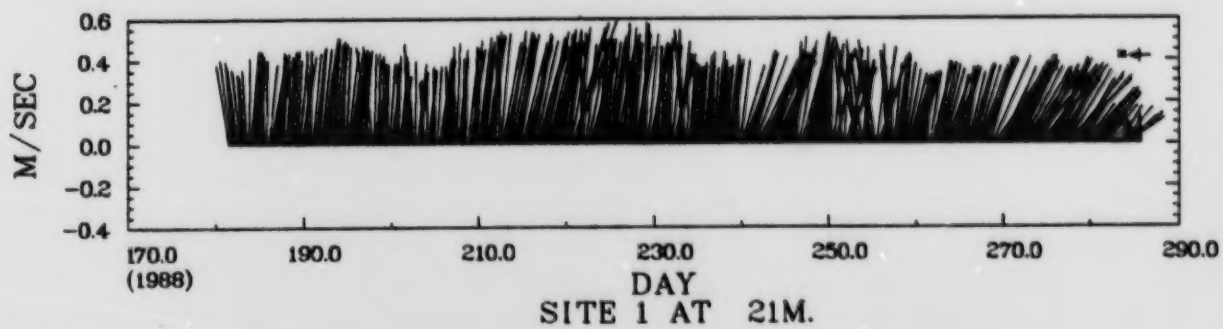
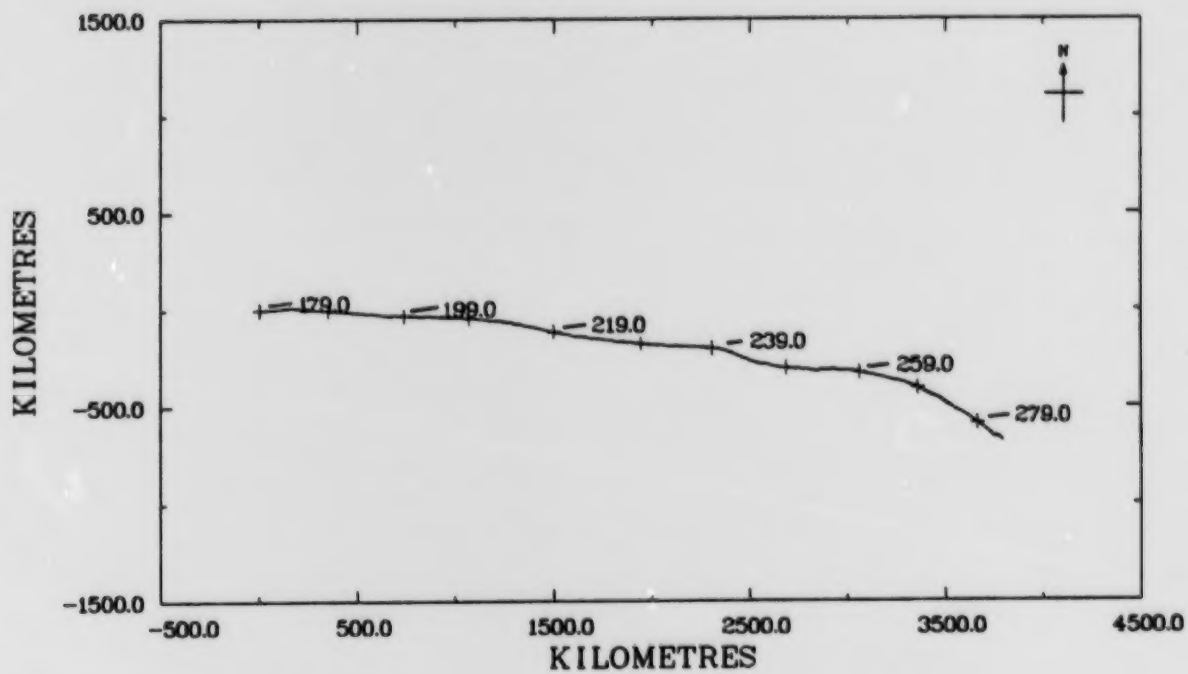
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 1 AT 21 M.



SITE 1 AT 21 M.



STATISTICS
Site 1 at 43 m, 1988
(Mooring 889)

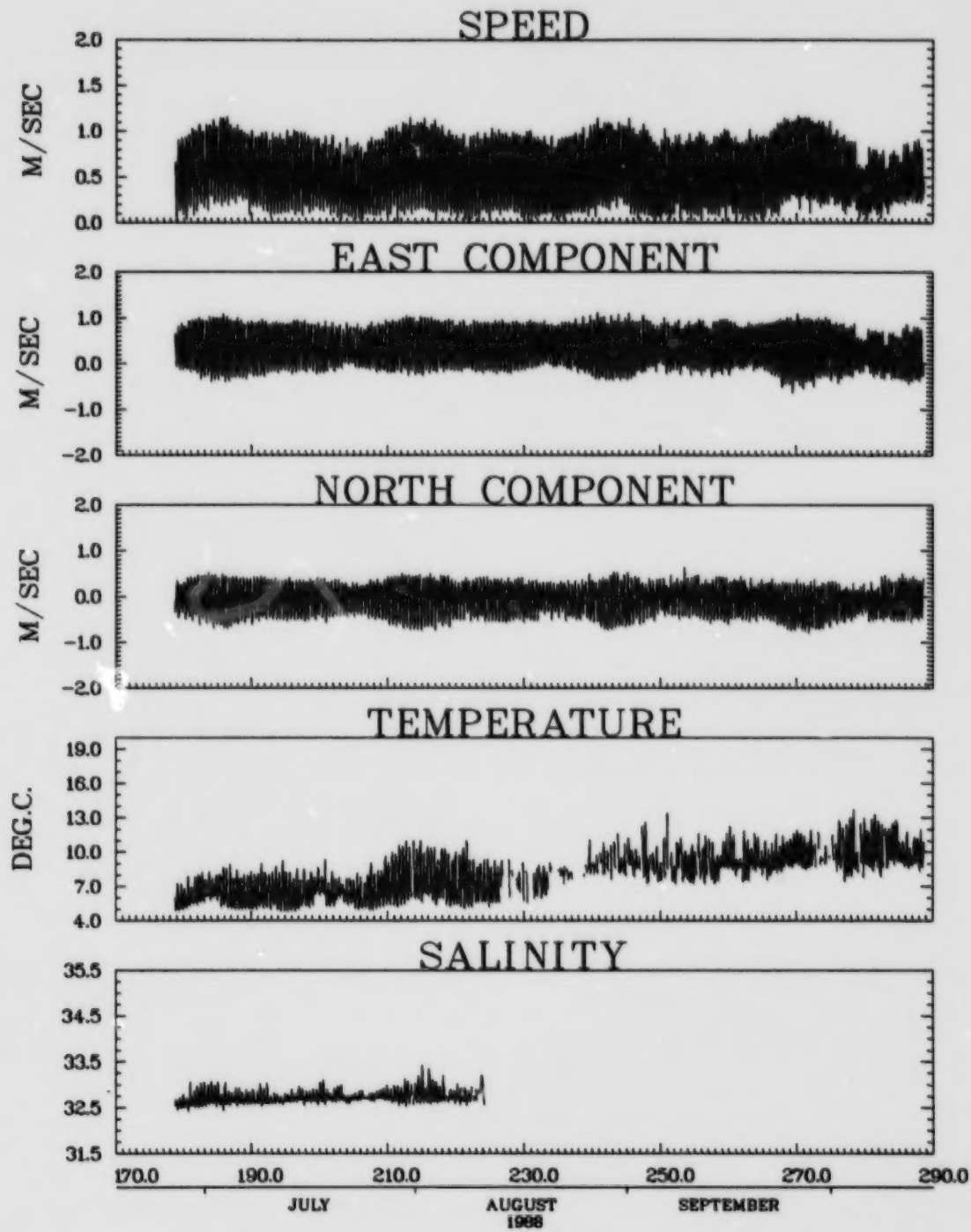
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2641	104	744	744	720	329
$\bar{X}$	0.339	0.373	0.355	0.375	0.343	0.207
Σ_1	0.400	0.390	0.399	0.399	0.411	0.358
Σ_6	0.059	0.021	0.027	0.034	0.047	0.057
North Velocity Component (m.s^{-1})						
N	2641	104	744	744	720	329
$\bar{X}$	-0.063	-0.046	-0.049	-0.052	-0.075	-0.098
Σ_1	0.322	0.320	0.329	0.331	0.322	0.287
Σ_6	0.048	0.023	0.027	0.027	0.069	0.034
Temperature ($^{\circ}\text{C}$)						
N	2257	104	740	516	610	287
$\bar{X}$	7.98	6.11	6.63	7.69	9.21	9.99
Σ_1	1.81	0.88	1.25	1.43	1.07	1.39
Σ_6	1.34	0.16	0.39	0.35	0.45	0.46
Salinity (PSS78)						
N	1059	104	740	215		
$\bar{X}$	32.73	32.65	32.73	32.79		
Σ_1	0.14	0.15	0.12	0.17		
Σ_6	0.05	0.03	0.04	0.05		
Sigma-theta (kg.m^{-3})						
N	1059	104	740	215		
$\bar{X}$	25.66	25.68	25.67	25.60		
Σ_1	0.26	0.20	0.24	0.34		
Σ_6	0.05	0.00	0.05	0.04		

N: number of samples in statistics

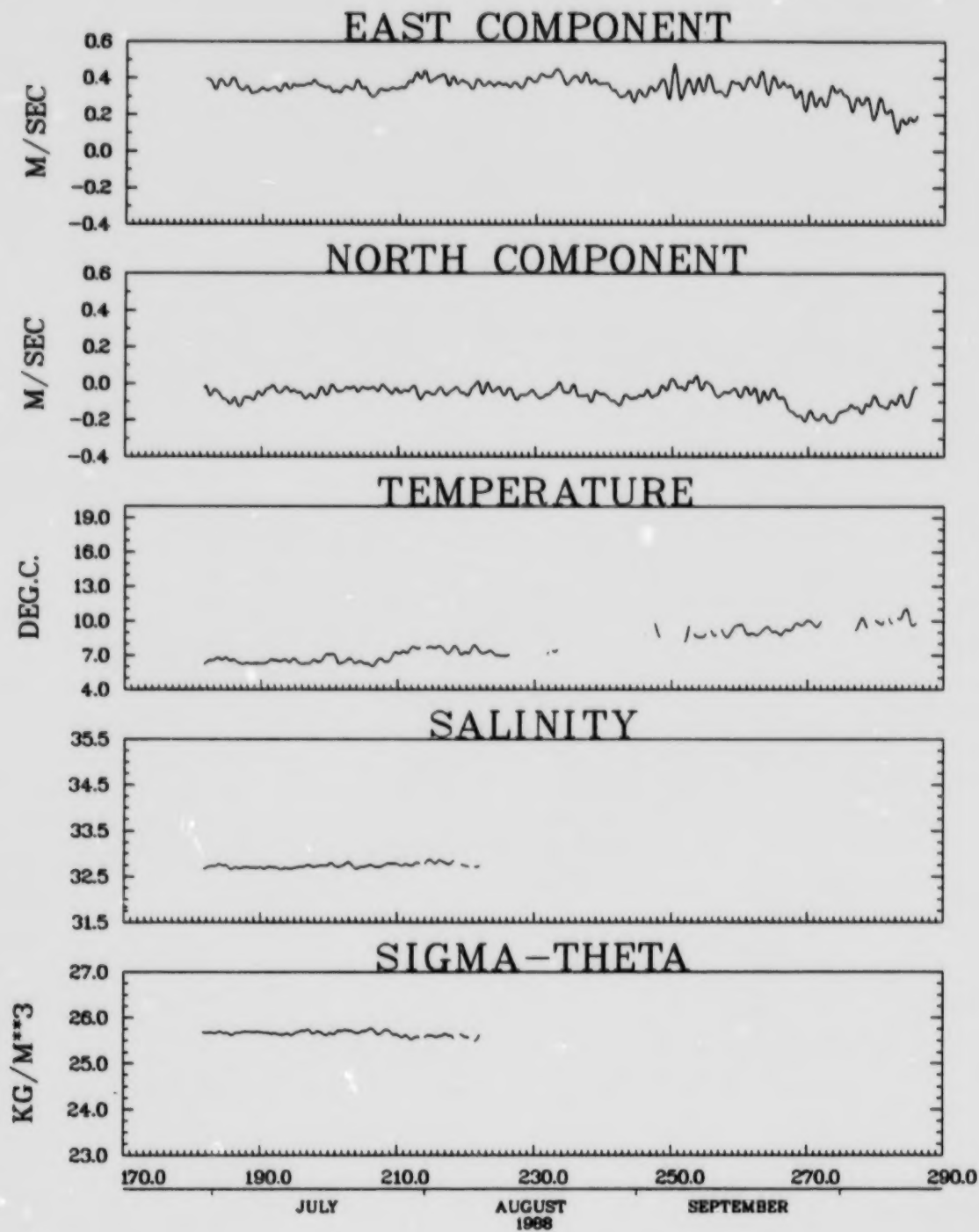
$\bar{X}$: mean value

Σ_1 : standard deviation of 1-hr time series

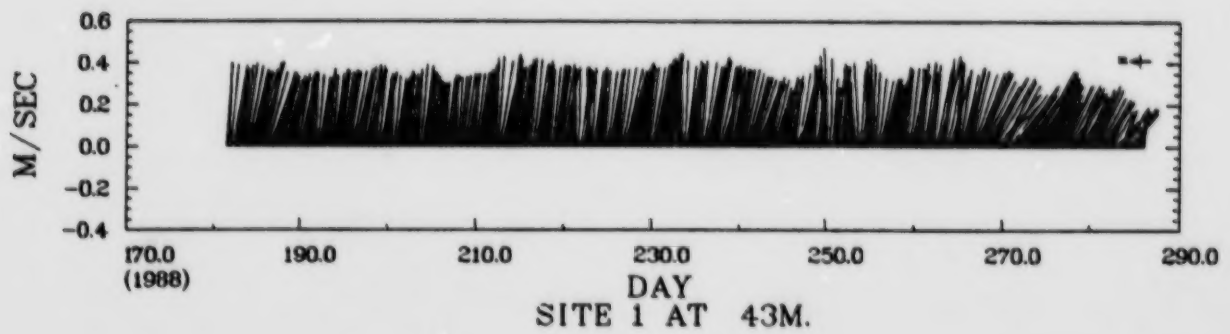
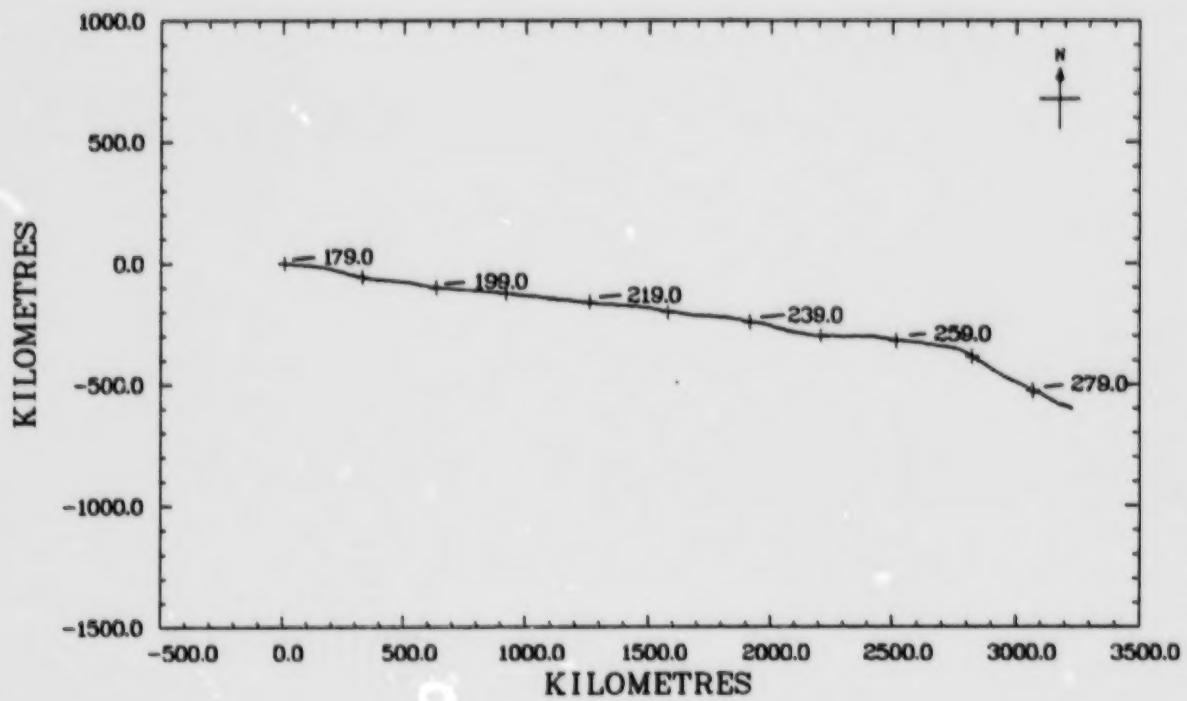
Σ_6 : standard deviation of 6-hr time series



SITE 1 AT 43 M.



SITE 1 AT 43 M.



STATISTICS

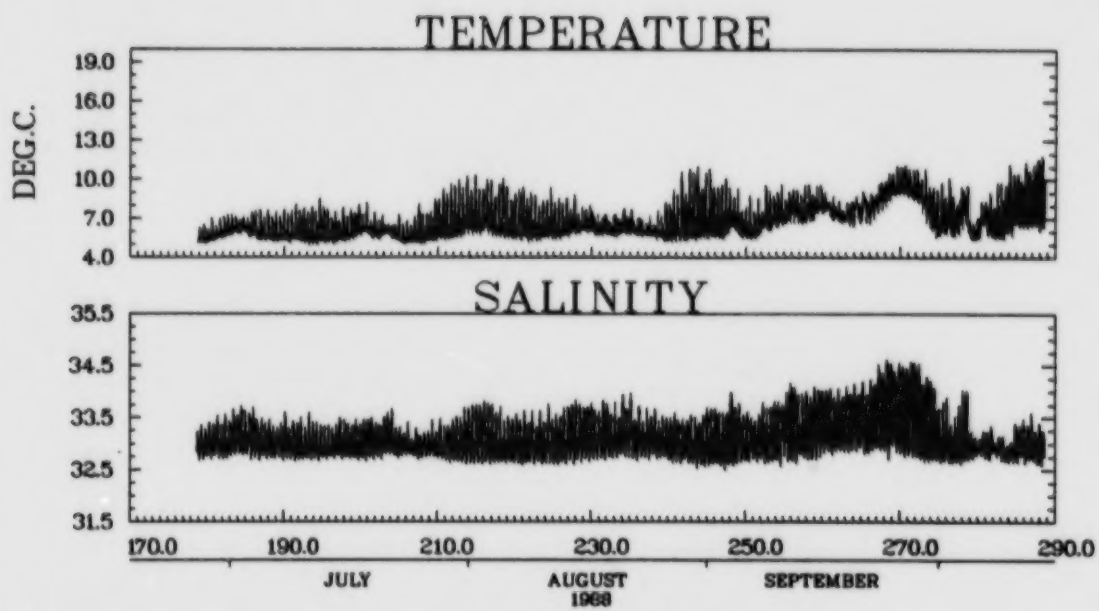
Site 1 at 67 m, 1988

(Mooring 889)

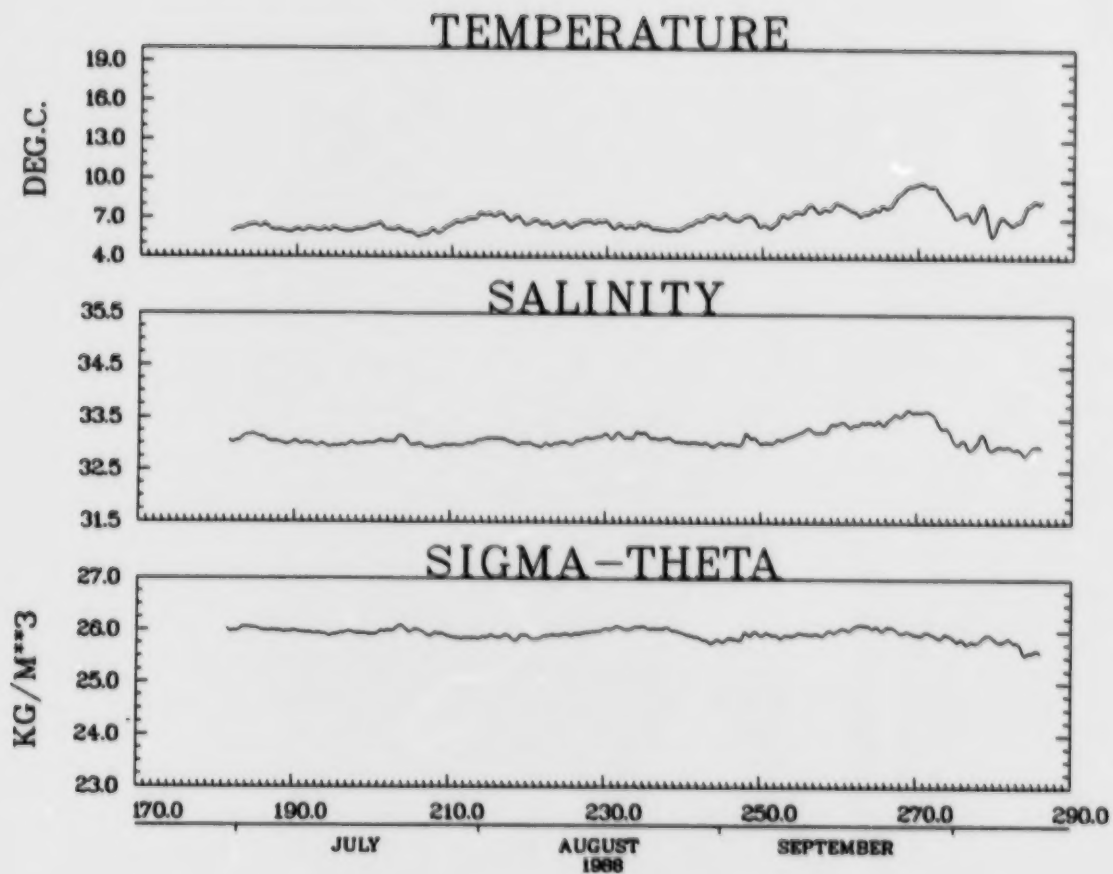
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Temperature ($^{\circ}\text{C}$)						
N	2641	104	744	744	720	329
$\bar{X}$	6.93	5.83	6.22	6.66	7.85	7.50
Σ_1	1.36	0.54	0.93	1.12	1.25	1.61
Σ_6	0.89	0.12	0.33	0.35	0.91	0.71
Salinity (PSS78)						
N	2641	104	744	744	720	329
$\bar{X}$	33.11	33.02	33.02	33.08	33.32	32.97
Σ_1	0.40	0.26	0.27	0.35	0.52	0.28
Σ_6	0.18	0.01	0.06	0.07	0.21	0.09
Sigma-theta (kg.m^{-3})						
N	2641	104	744	744	720	329
$\bar{X}$	25.93	26.00	25.96	25.94	25.97	25.74
Σ_1	0.38	0.24	0.30	0.37	0.44	0.38
Σ_6	0.10	0.02	0.06	0.08	0.08	0.11

N: number of samples in statistics

 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 1 AT 67 M.



SITE 1 AT 67 M.

NO PROGRESSIVE VECTOR AND STICK PLOTS
FOR SITE 1 AT 67 M.

STATISTICS

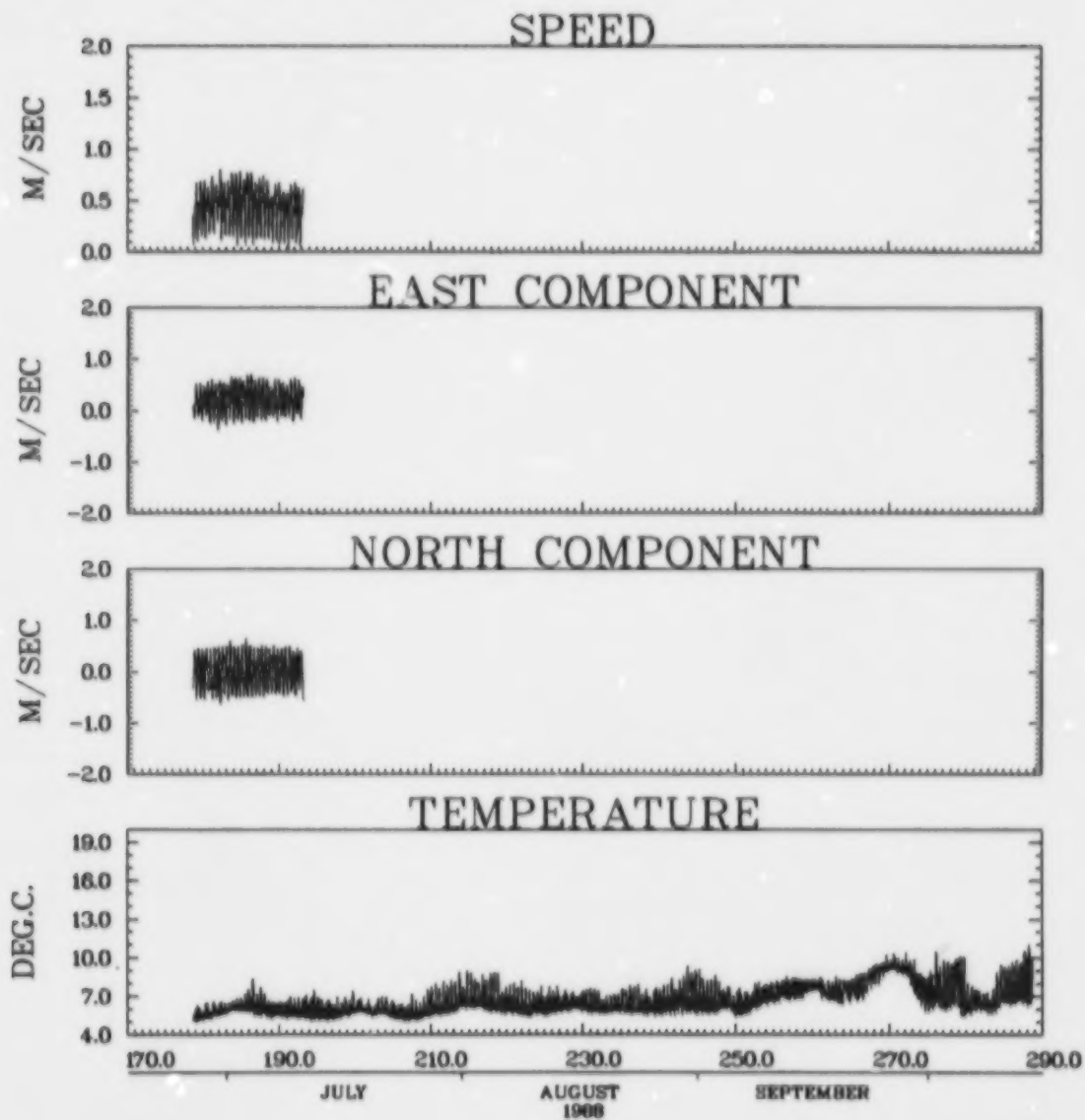
Site 1 at 90 m, 1988

(Mooring 889)

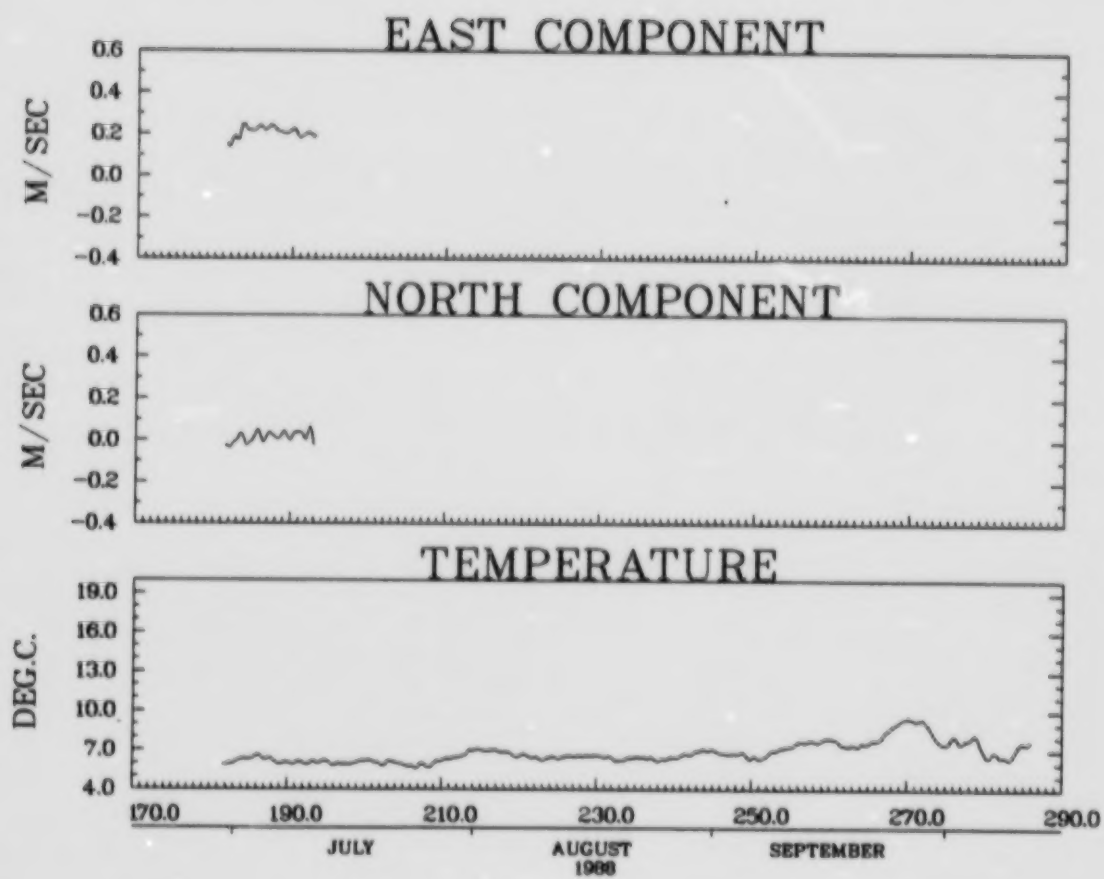
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	350	104	246			
$\bar{X}$	0.201	0.168	0.215			
Σ_1	0.274	0.273	0.274			
Σ_6	0.025	0.020	0.018			
North Velocity Component (m.s^{-1})						
N	350	104	246			
$\bar{X}$	0.008	-0.014	0.017			
Σ_1	0.350	0.353	0.349			
Σ_6	0.025	0.012	0.022			
Temperature ($^{\circ}\text{C}$)						
N	2641	104	744	744	720	329
$\bar{X}$	6.82	5.75	6.12	6.59	7.67	7.43
Σ_1	1.11	0.41	0.61	0.74	1.06	1.33
Σ_6	0.83	0.03	0.25	0.24	0.87	0.58

N: number of samples in statistics

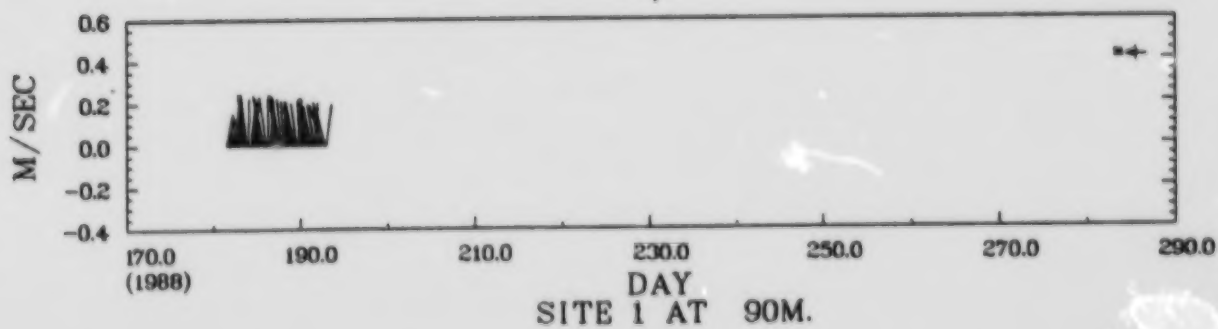
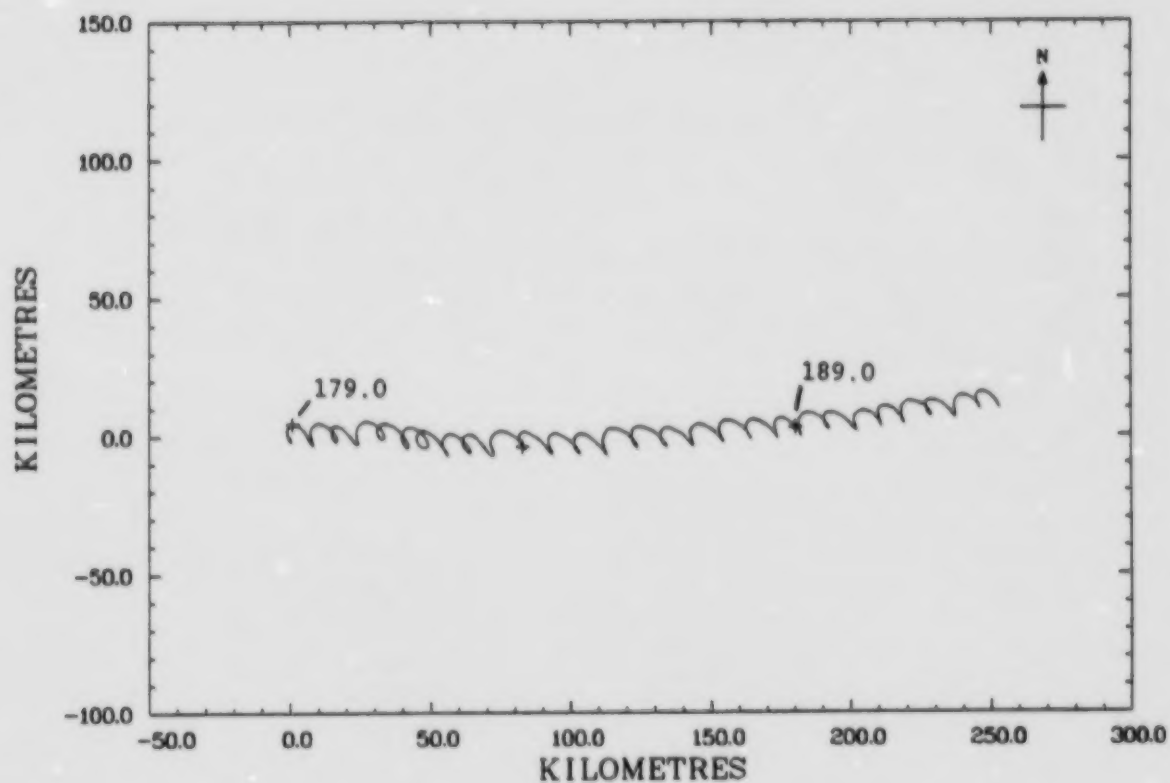
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 1 AT 90 M.



SITE 1 AT 90 M.



STATISTICS

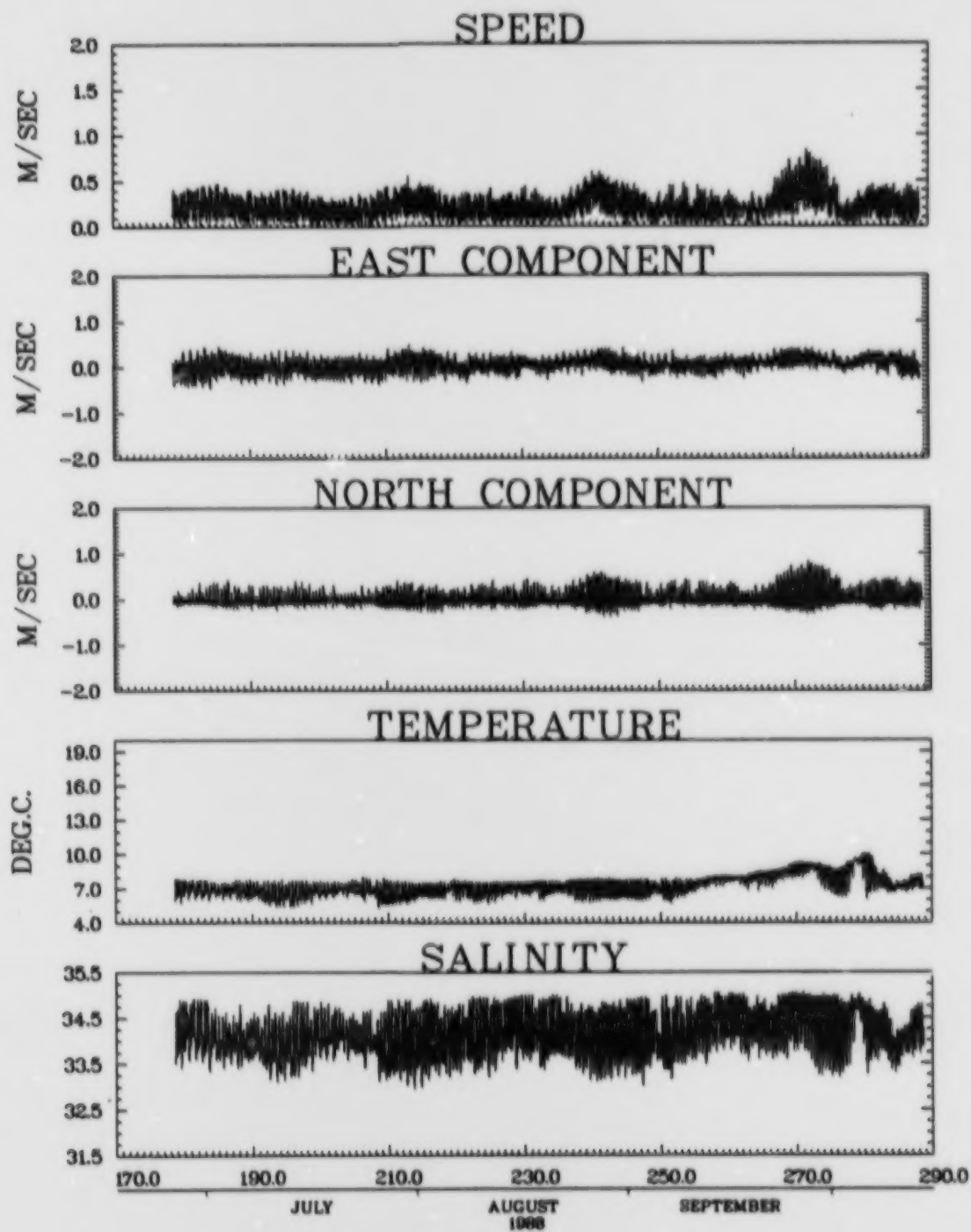
Site 1 at 145 m, 1988

(Mooring 889)

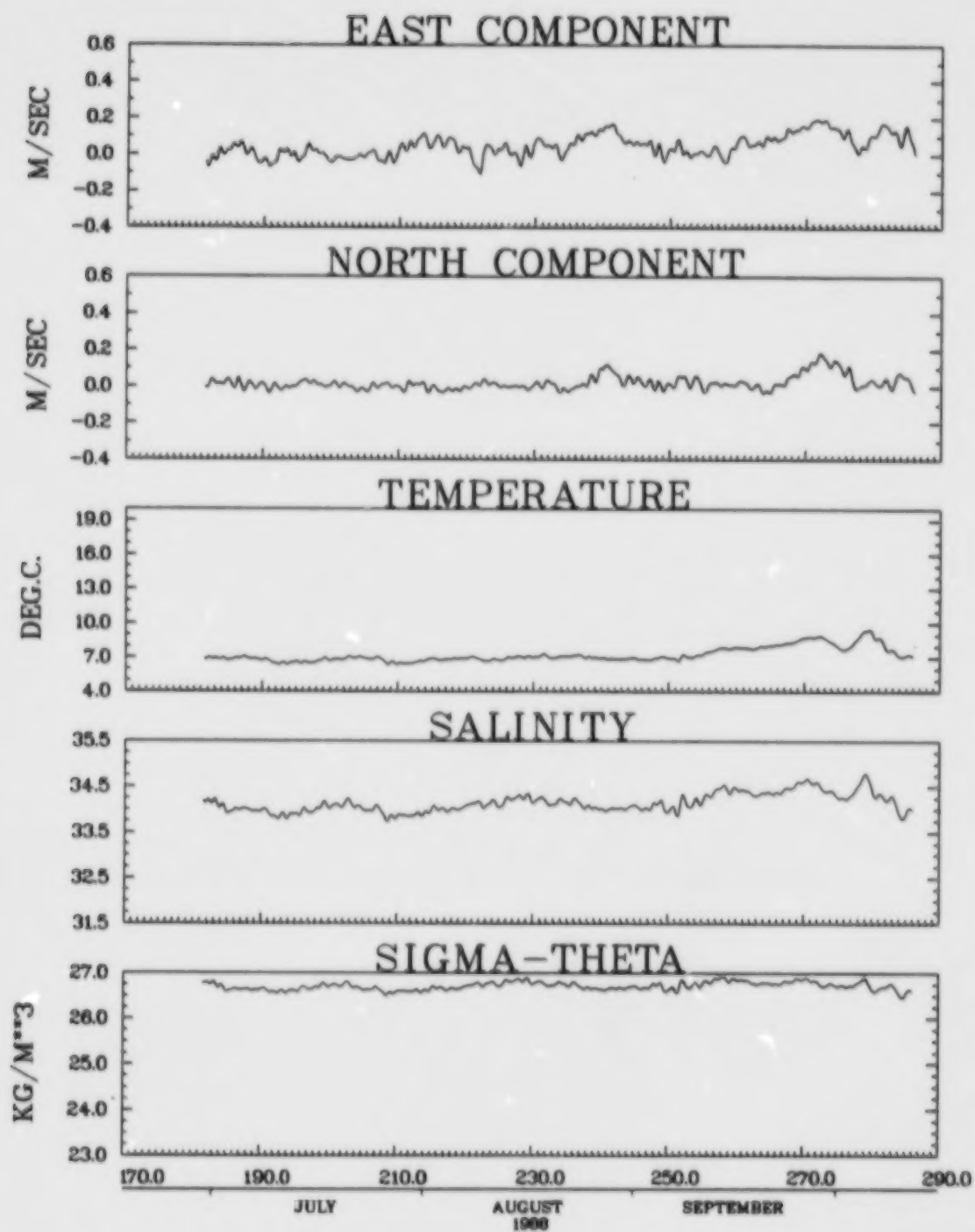
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2641	104	744	744	720	329
$\bar{X}$	0.044	-0.037	0.006	0.052	0.072	0.075
Σ_1	0.169	0.232	0.193	0.158	0.142	0.142
Σ_6	0.062	0.023	0.038	0.055	0.063	0.047
North Velocity Component (m.s^{-1})						
N	2641	104	744	744	720	329
$\bar{X}$	0.020	-0.004	0.003	0.013	0.040	0.036
Σ_1	0.184	0.094	0.138	0.187	0.223	0.193
Σ_6	0.040	0.020	0.018	0.035	0.052	0.037
Temperature ($^{\circ}\text{C}$)						
N	2641	104	744	744	720	329
$\bar{X}$	7.23	6.97	6.72	6.95	7.74	7.98
Σ_1	0.87	0.57	0.62	0.59	0.80	1.00
Σ_6	0.67	0.05	0.20	0.14	0.65	0.75
Salinity (PSS78)						
N	2641	104	744	744	720	329
$\bar{X}$	34.15	34.20	33.97	34.10	34.32	34.27
Σ_1	0.49	0.41	0.42	0.50	0.49	0.45
Σ_6	0.21	0.04	0.11	0.10	0.20	0.24
Sigma-theta (kg.m^{-3})						
N	2641	104	744	744	720	329
$\bar{X}$	26.71	26.79	26.64	26.72	26.77	26.70
Σ_1	0.29	0.25	0.25	0.32	0.32	0.24
Σ_6	0.09	0.02	0.06	0.07	0.08	0.10

N: number of samples in statistics

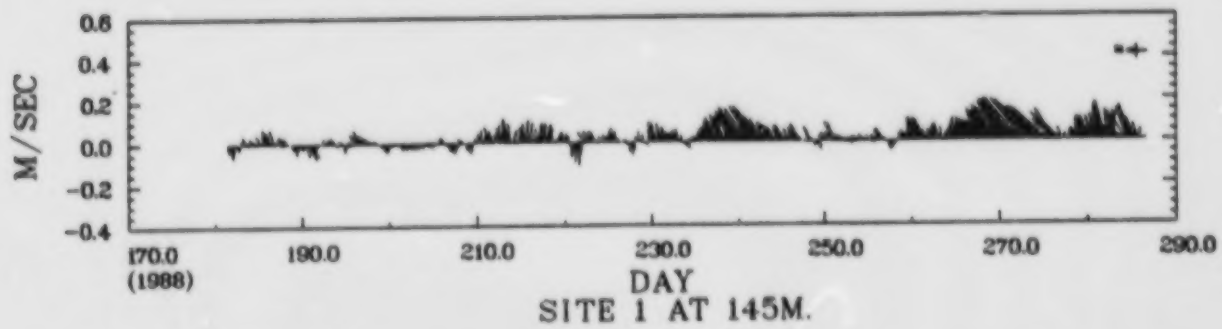
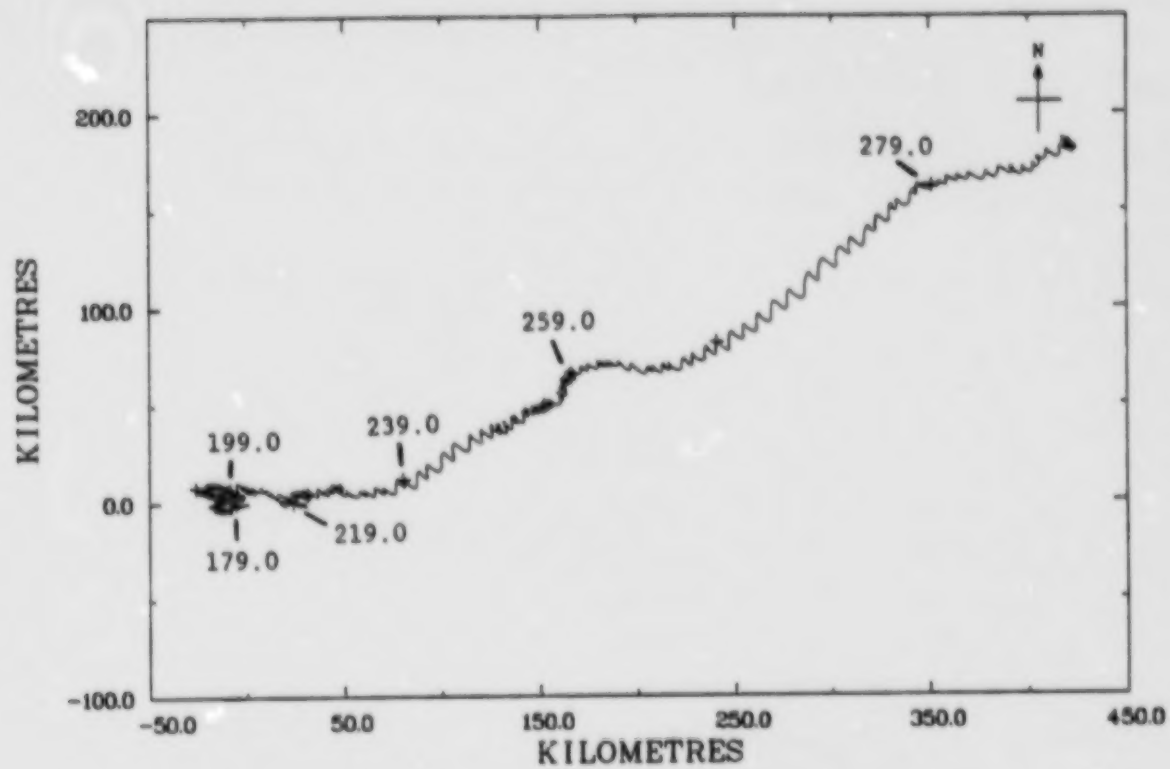
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 1 AT 145 M.



SITE 1 AT 145 M.



STATISTICS

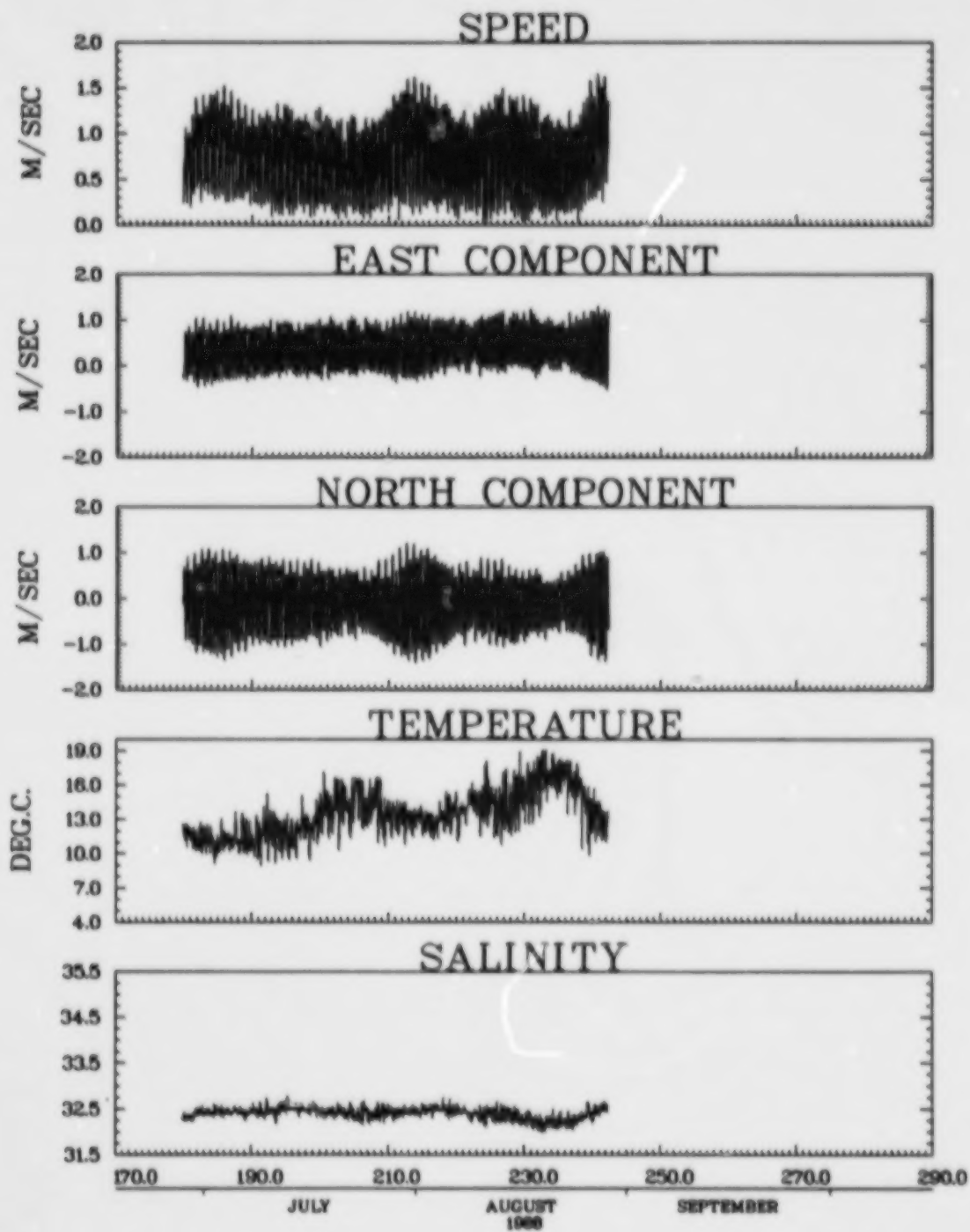
Site 2 at 11 m, 1988

(Moorings 891, 912, 919)

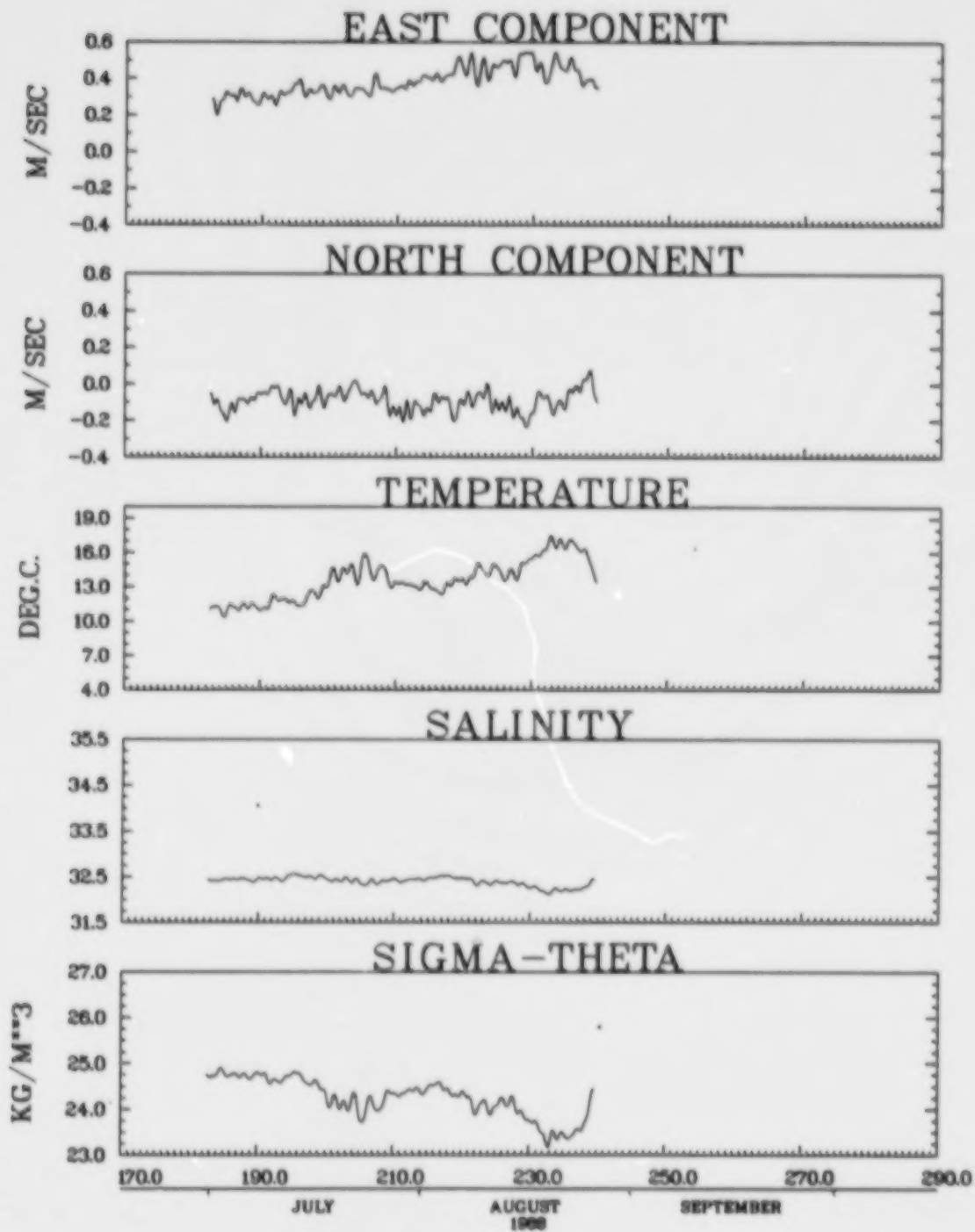
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	1499	76	744	679		
$\bar{X}$	0.376	0.249	0.330	0.441		
Σ_1	0.429	0.428	0.418	0.433		
Σ_6	0.077	0.001	0.040	0.054		
North Velocity Component (m.s^{-1})						
N	1499	76	744	679		
$\bar{X}$	-0.090	-0.088	-0.086	-0.095		
Σ_1	0.626	0.700	0.645	0.597		
Σ_6	0.056	0.009	0.050	0.062		
Temperature ($^{\circ}\text{C}$)						
N	1499	76	744	679		
$\bar{X}$	13.49	11.50	12.66	14.62		
Σ_1	2.04	0.73	1.72	1.83		
Σ_6	1.74	0.09	1.37	1.39		
Salinity (PSS78)						
N	1499	76	744	679		
$\bar{X}$	32.40	32.36	32.44	32.36		
Σ_1	0.12	0.08	0.09	0.14		
Σ_6	0.09	0.02	0.05	0.11		
Sigma-theta (kg.m^{-3})						
N	1499	76	744	679		
$\bar{X}$	24.27	24.63	24.47	24.01		
Σ_1	0.49	0.17	0.38	0.49		
Σ_6	0.42	0.03	0.29	0.39		

N: number of samples in statistics

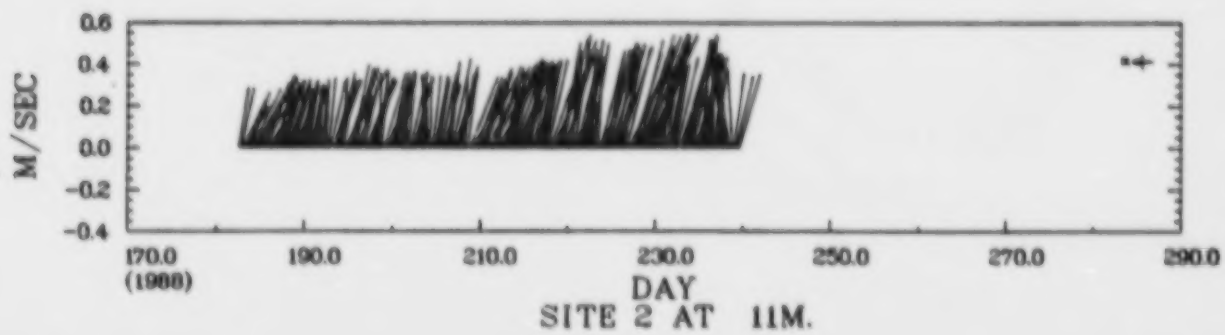
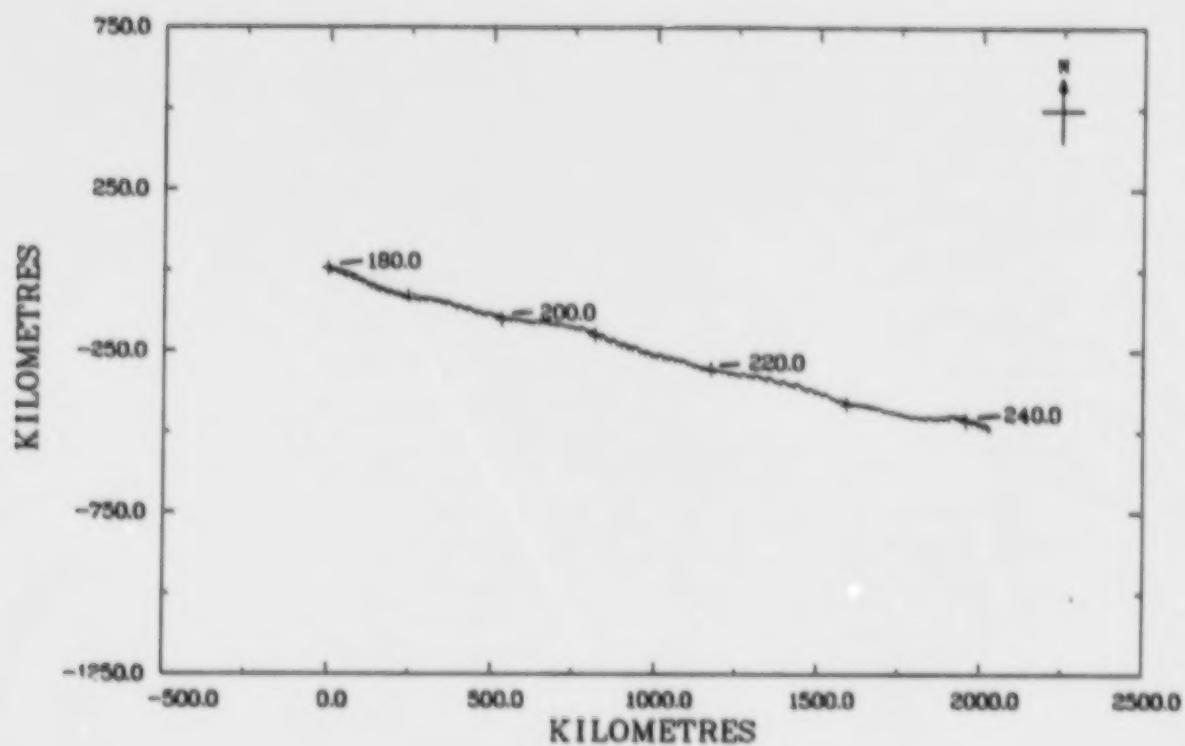
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 2 AT 11 M.



SITE 2 AT 11 M.



STATISTICS

Site 2 at 35 m, 1988
(Moorings 891, 912, 919)

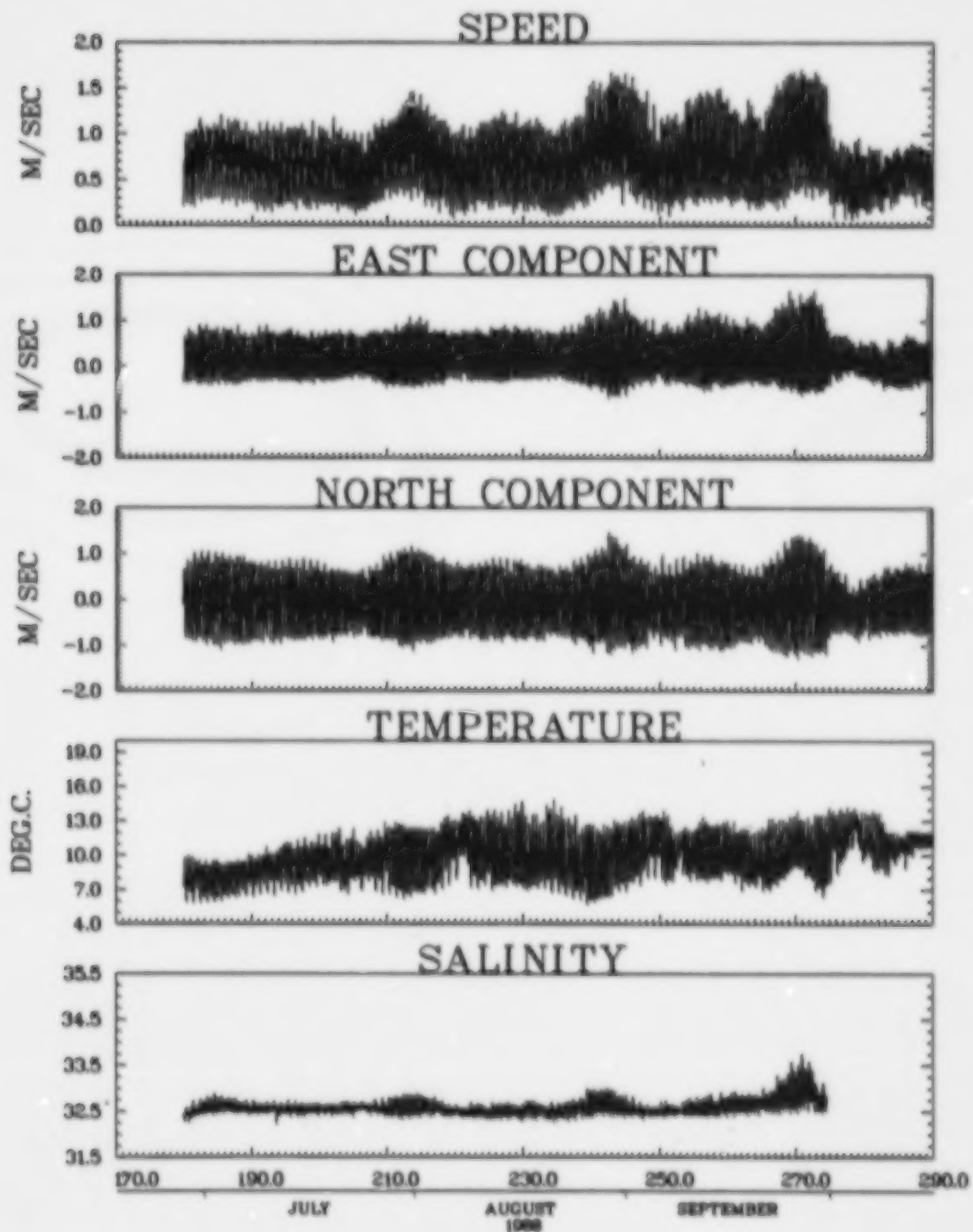
RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})					
N	2637	76	744	720	353
$\bar{X}$	0.211	0.150	0.199	0.234	0.099
Σ_1	0.442	0.397	0.393	0.454	0.314
Σ_6	0.062	0.022	0.025	0.027	0.077
North Velocity Component (m.s^{-1})					
N	2637	76	744	720	353
$\bar{X}$	-0.034	-0.002	-0.034	-0.031	-0.027
Σ_1	0.616	0.615	0.613	0.637	0.474
Σ_6	0.060	0.003	0.044	0.052	0.088
Temperature ($^{\circ}\text{C}$)					
N	2637	76	744	720	353
$\bar{X}$	9.94	8.00	9.06	10.07	11.24
Σ_1	1.93	1.18	1.55	2.16	1.26
Σ_6	0.91	0.00	0.64	0.64	0.62
Salinity (PSS78)					
N	2272	76	744	708	
$\bar{X}$	32.59	32.50	32.57	32.55	32.68
Σ_1	0.18	0.13	0.11	0.14	0.24
Σ_6	0.11	0.00	0.03	0.06	0.16
Sigma-theta (kg.m^{-3})					
N	2272	76	744	708	
$\bar{X}$	25.10	25.30	25.19	25.01	25.08
Σ_1	0.42	0.26	0.32	0.45	0.45
Σ_6	0.16	0.00	0.11	0.14	0.17

N: number of samples in statistics

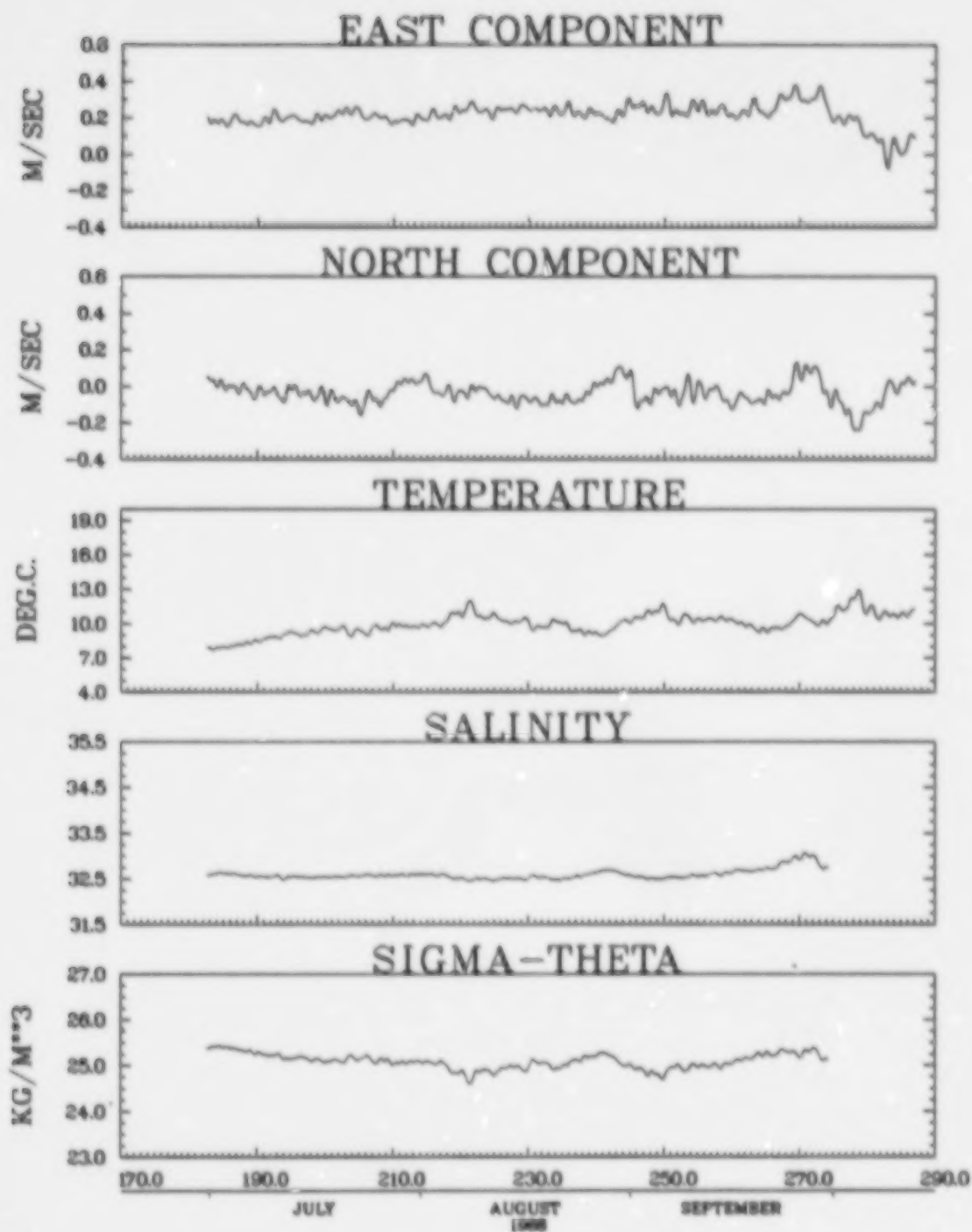
$\bar{X}$: mean value

Σ_1 : standard deviation of 1-hr time series

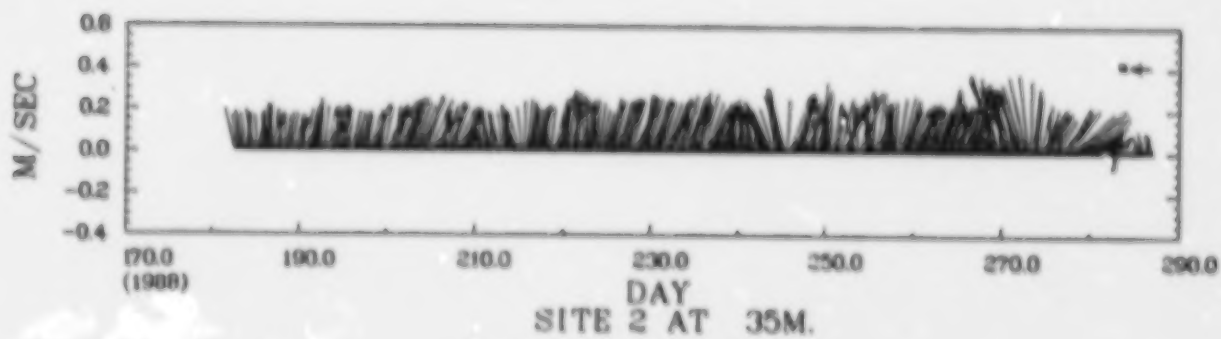
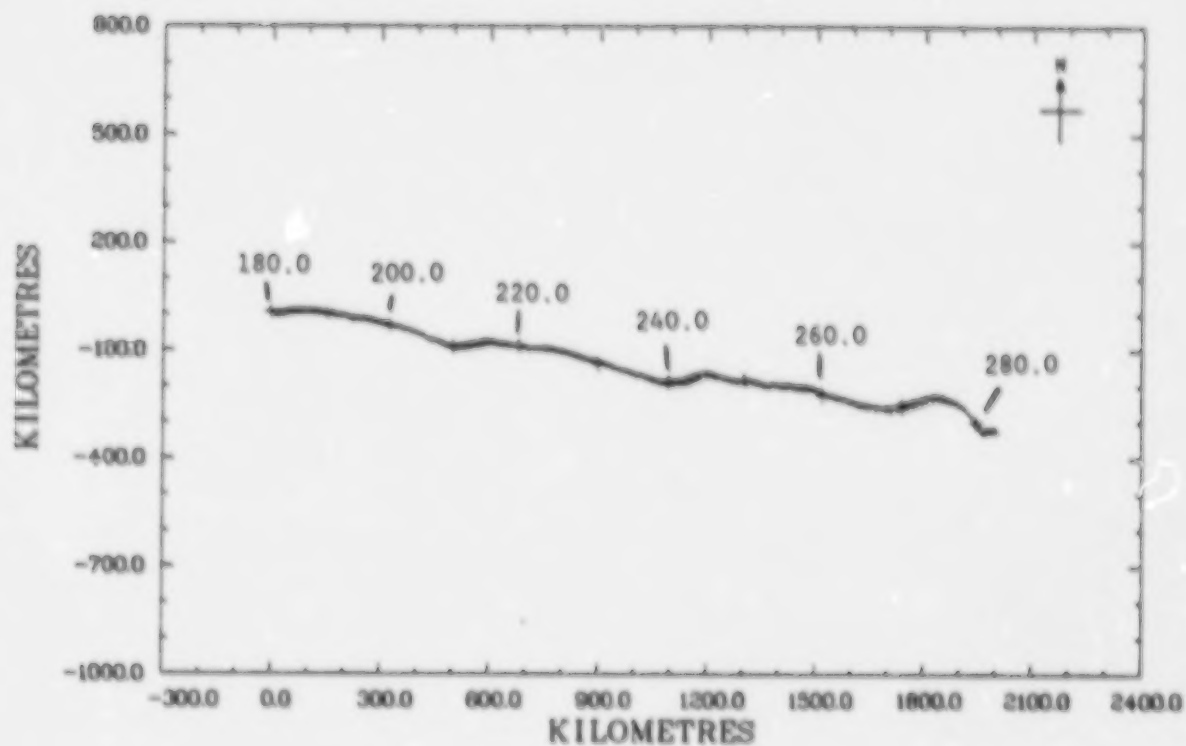
Σ_6 : standard deviation of 6-hr time series



SITE 2 AT 35 M.



SITE 2 AT 35 M.



STATISTICS

Site 2 at 57 m, 1988
(Moorings 891, 912, 919)

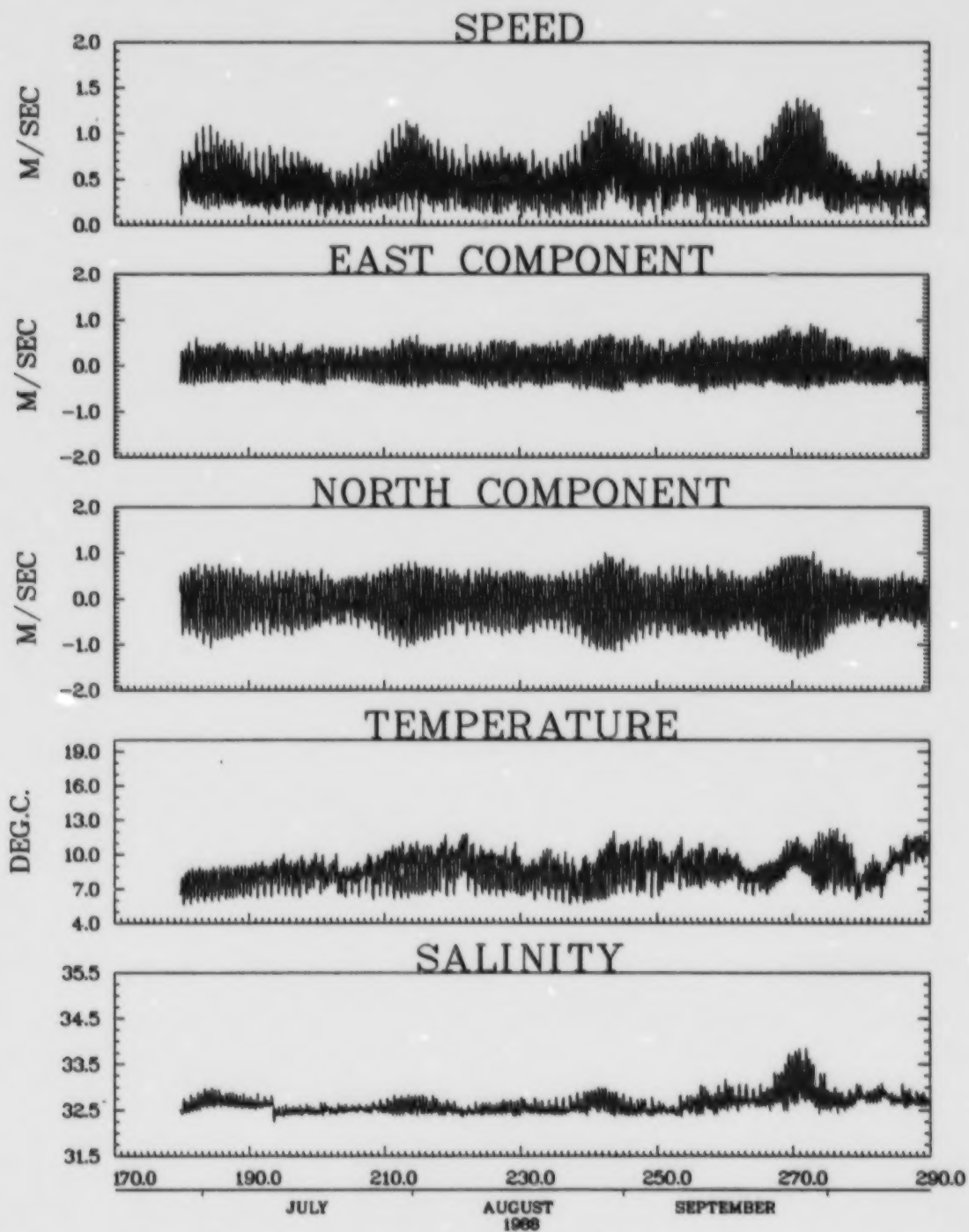
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2638	76	744	744	720	354
$\bar{X}$	0.028	0.011	0.034	0.021	0.051	-0.009
Σ_1	0.301	0.284	0.257	0.311	0.350	0.255
Σ_6	0.040	0.005	0.024	0.026	0.049	0.045
North Velocity Component (m.s^{-1})						
N	2638	76	744	744	720	354
$\bar{X}$	-0.056	-0.016	-0.053	-0.056	-0.088	-0.003
Σ_1	0.478	0.485	0.450	0.491	0.537	0.358
Σ_6	0.039	0.012	0.024	0.030	0.027	0.040
Temperature ($^{\circ}\text{C}$)						
N	2638	76	744	744	720	354
$\bar{X}$	8.61	7.33	8.17	8.60	8.92	9.21
Σ_1	1.37	0.98	1.11	1.48	1.23	1.51
Σ_6	0.66	0.01	0.42	0.62	0.51	0.91
Salinity (PSS78)						
N	2638	76	744	744	720	354
$\bar{X}$	32.64	32.60	32.58	32.56	32.73	32.76
Σ_1	0.20	0.13	0.13	0.13	0.28	0.13
Σ_6	0.15	0.01	0.09	0.06	0.19	0.07
Sigma-theta (kg.m^{-3})						
N	2638	76	744	744	720	354
$\bar{X}$	25.33	25.48	25.34	25.26	25.34	25.37
Σ_1	0.31	0.22	0.25	0.31	0.35	0.31
Σ_6	0.15	0.01	0.12	0.12	0.16	0.18

N: number of samples in statistics

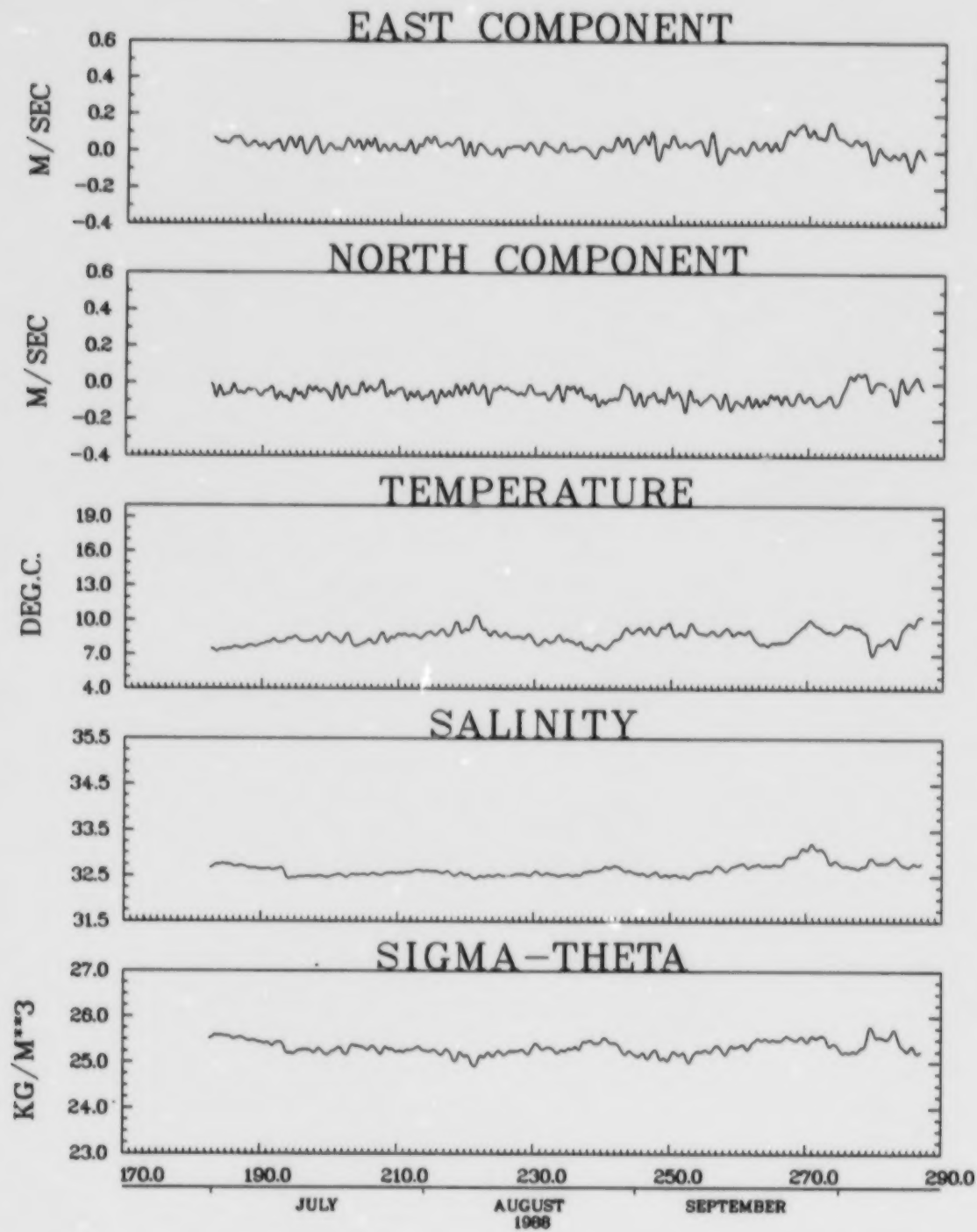
$\bar{X}$: mean value

Σ_1 : standard deviation of 1-hr time series

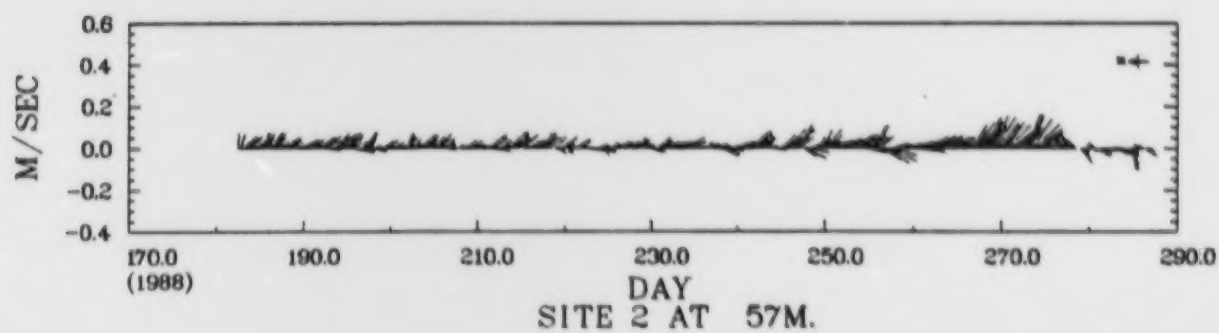
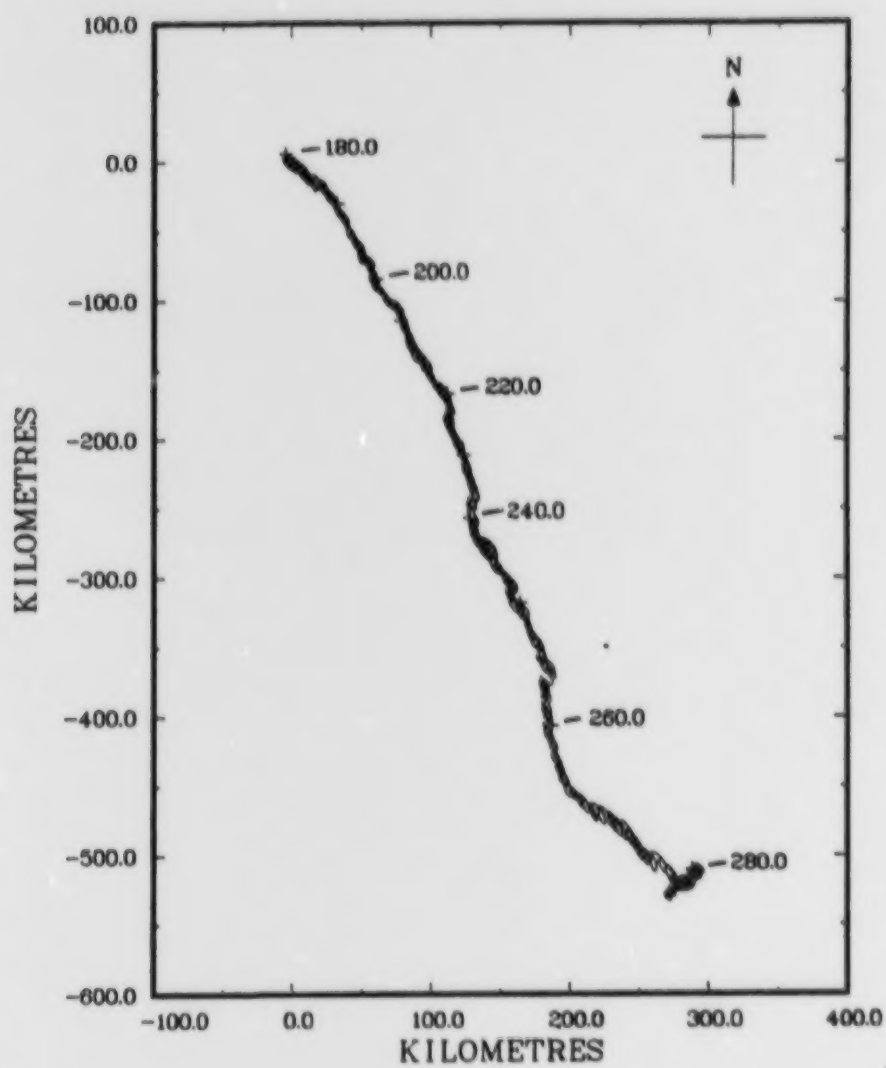
Σ_6 : standard deviation of 6-hr time series



SITE 2 AT 57 M.



SITE 2 AT 57 M.



STATISTICS

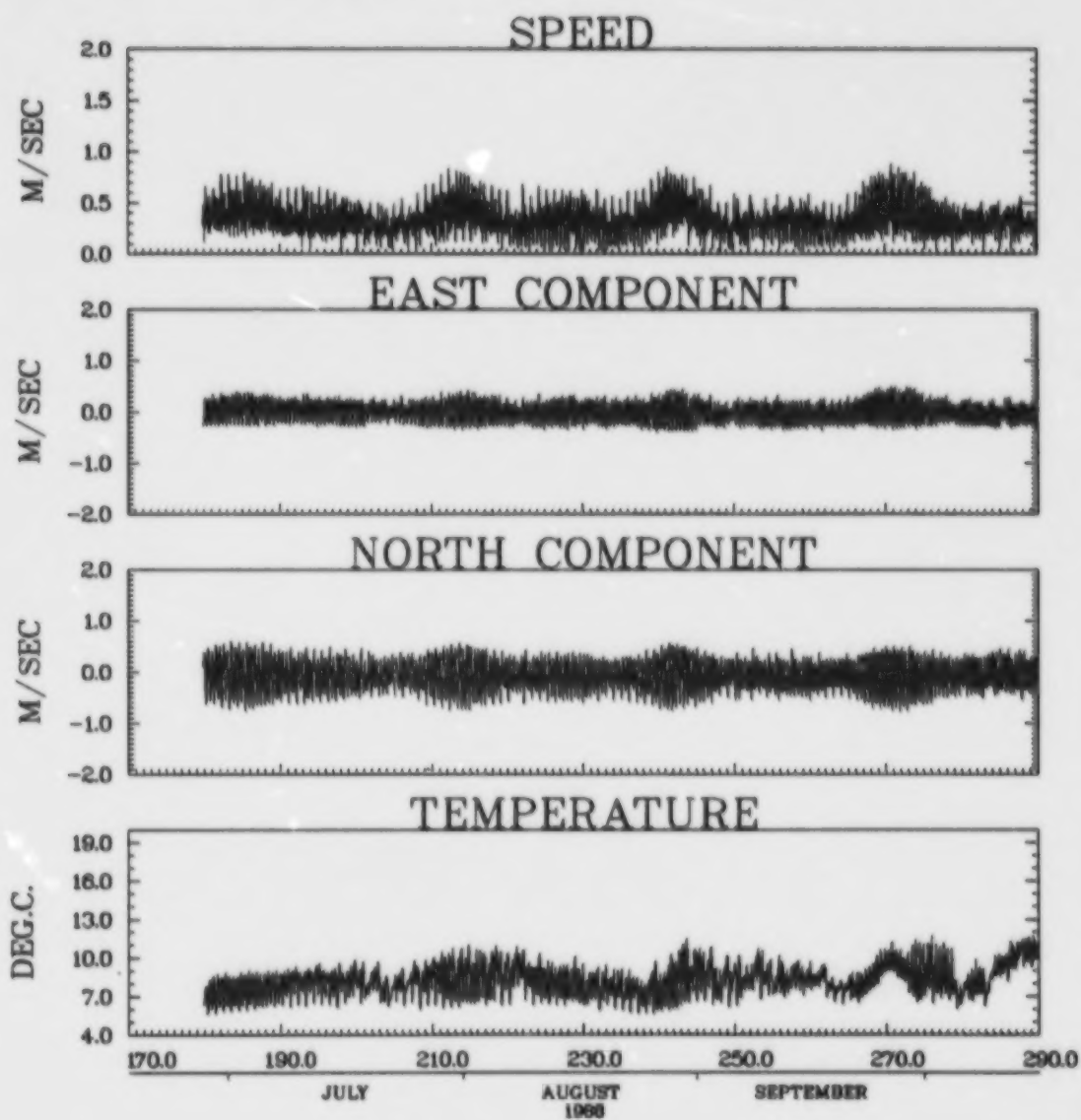
Site 2 at 64 m, 1988

(Moorings 891, 912, 919)

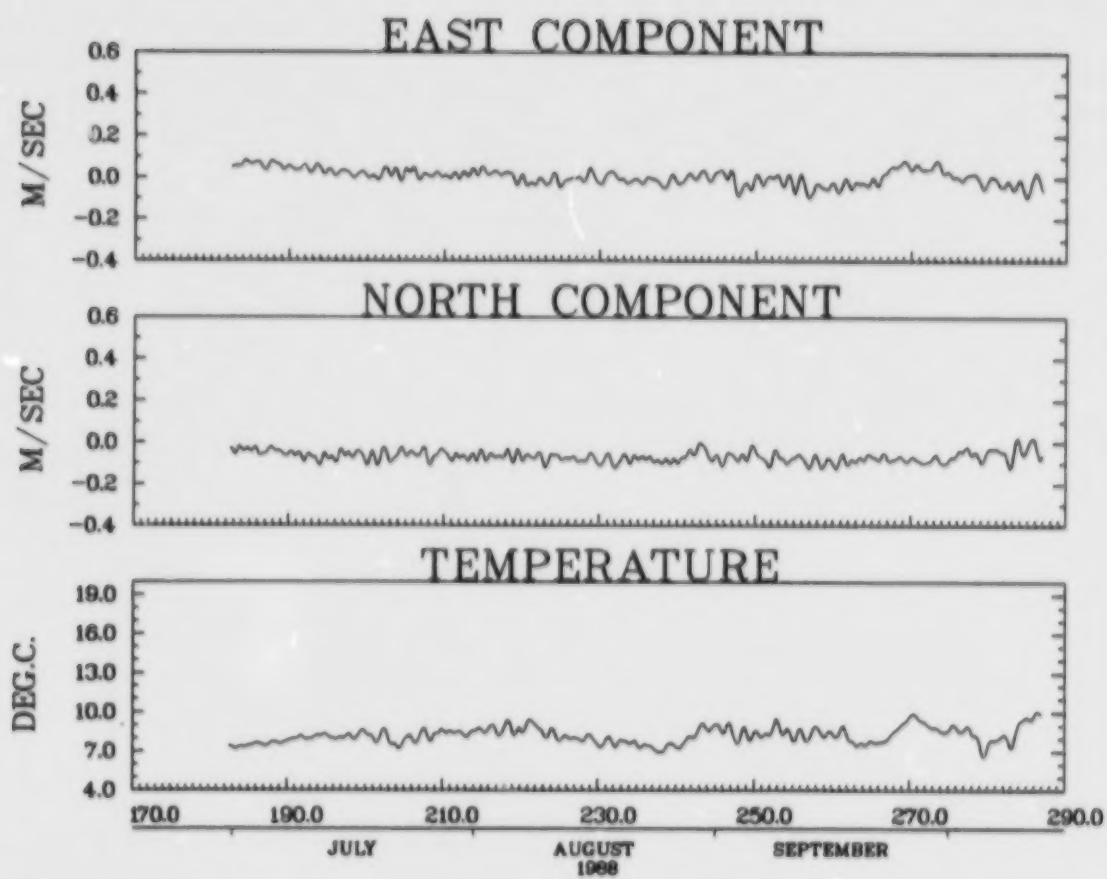
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2639	76	744	744	720	355
$\bar{X}$	0.005	0.017	0.031	-0.003	-0.003	-0.021
Σ_1	0.204	0.214	0.198	0.214	0.211	0.176
Σ_6	0.036	0.000	0.024	0.023	0.044	0.030
North Velocity Component (m.s^{-1})						
N	2639	76	744	744	720	355
$\bar{X}$	-0.066	-0.030	-0.061	-0.074	-0.080	-0.044
Σ_1	0.321	0.392	0.346	0.324	0.302	0.275
Σ_6	0.026	0.002	0.022	0.022	0.021	0.033
Temperature ($^{\circ}\text{C}$)						
N	2639	76	744	744	720	355
$\bar{X}$	8.24	7.23	7.99	8.11	8.45	8.86
Σ_1	1.21	0.96	1.05	1.27	1.03	1.42
Σ_6	0.63	0.02	0.39	0.61	0.58	0.88

N: number of samples in statistics

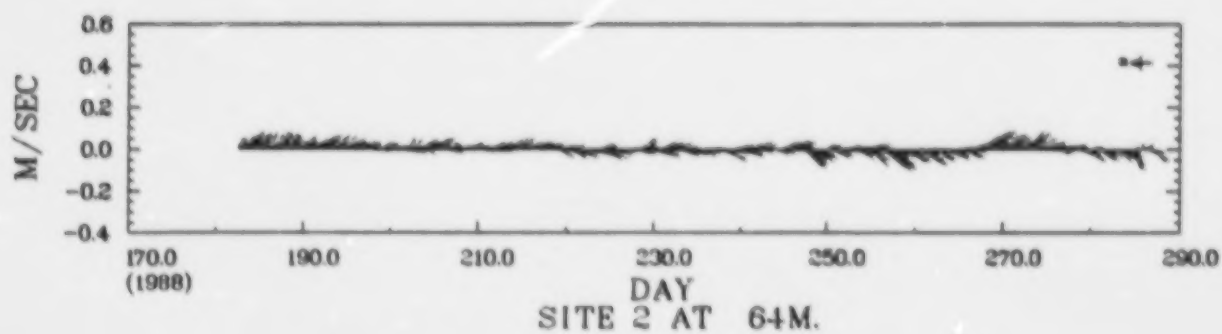
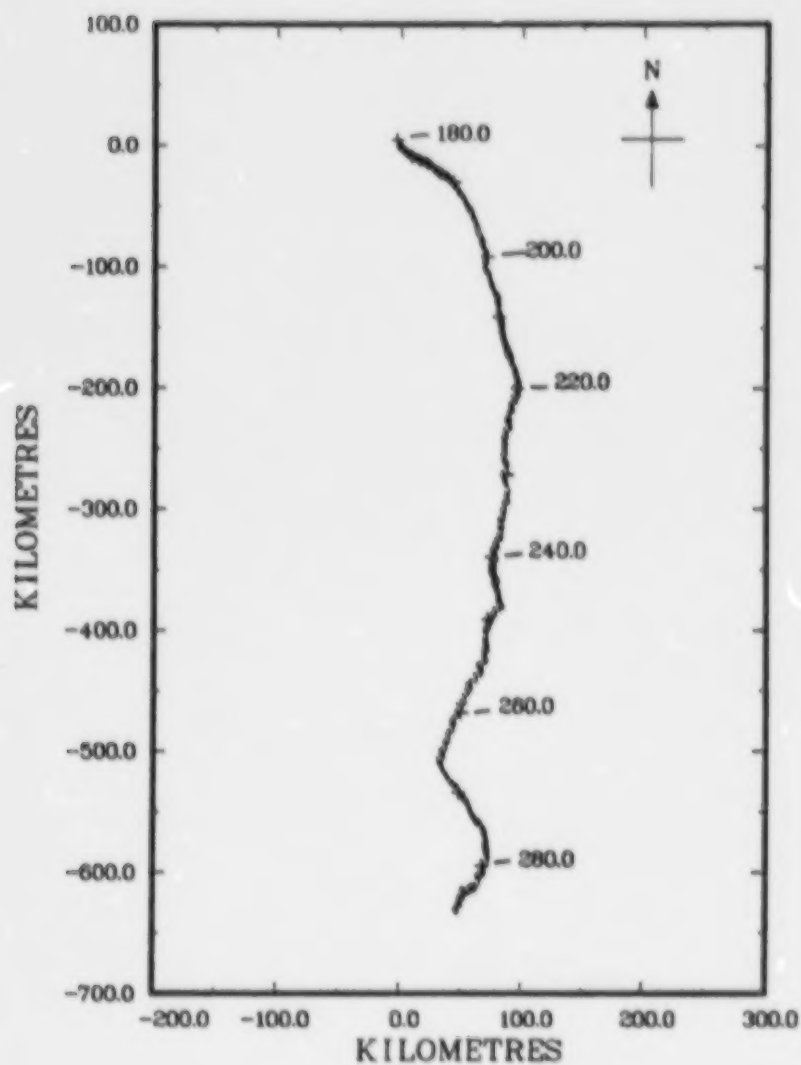
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 2 AT 64 M.



SITE 2 AT 64 M.



STATISTICS

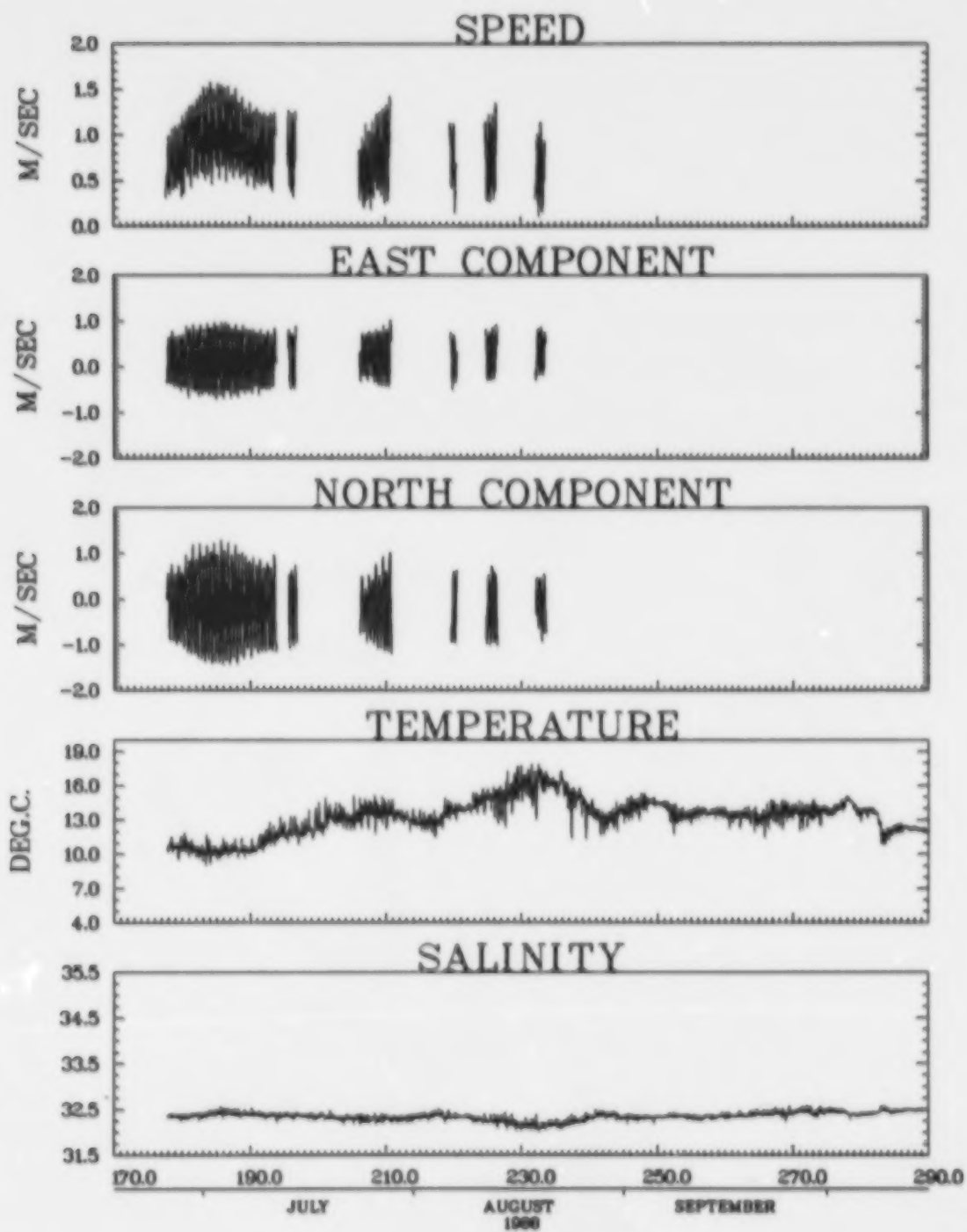
Site 3 at 12 m, 1988

(Moorings 893, 913)

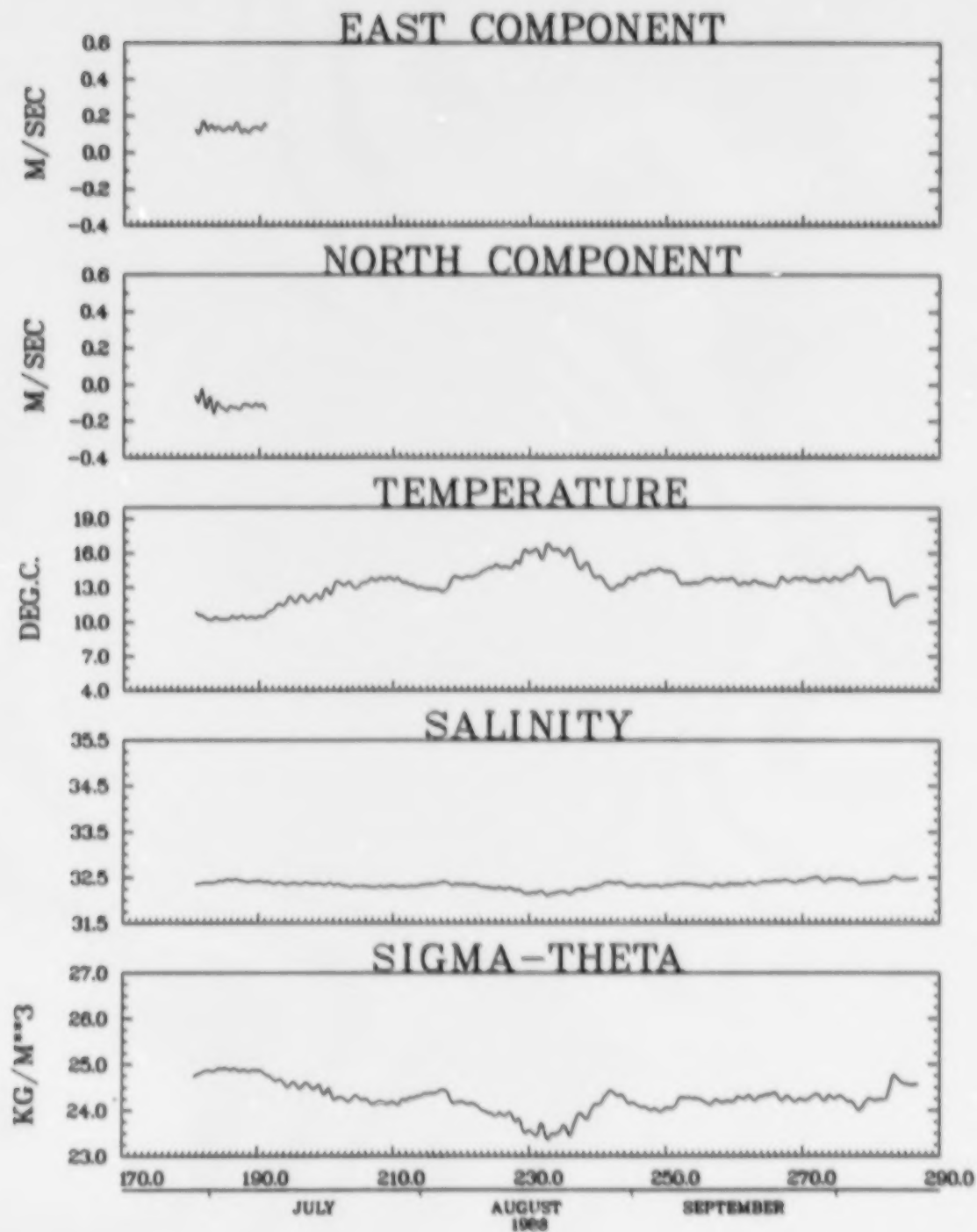
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	627	125	402	100		
$\bar{X}$	0.181	0.124	0.174	0.280		
Σ_1	0.477	0.475	0.492	0.400		
Σ_6	0.016	0.024	0.014			
North Velocity Component (m.s^{-1})						
N	627	125	402	100		
$\bar{X}$	-0.129	-0.095	-0.134	-0.149		
Σ_1	0.698	0.696	0.733	0.542		
Σ_6	0.027	0.033	0.014			
Temperature ($^{\circ}\text{C}$)						
N	2683	125	744	744	720	350
$\bar{X}$	13.28	10.58	12.16	14.51	13.74	13.09
Σ_1	1.56	0.44	1.40	1.35	0.58	1.02
Σ_6	1.45	0.23	1.31	1.20	0.38	0.99
Salinity (PSS78)						
N	2683	125	744	744	720	350
$\bar{X}$	32.36	32.36	32.36	32.28	32.38	32.45
Σ_1	0.09	0.04	0.06	0.09	0.07	0.05
Σ_6	0.08	0.02	0.05	0.08	0.05	0.04
Sigma-theta (kg.m^{-3})						
N	2683	125	744	744	720	350
$\bar{X}$	24.28	24.79	24.50	23.98	24.21	24.40
Σ_1	0.36	0.09	0.30	0.35	0.15	0.22
Σ_6	0.33	0.05	0.28	0.32	0.10	0.22

N: number of samples in statistics

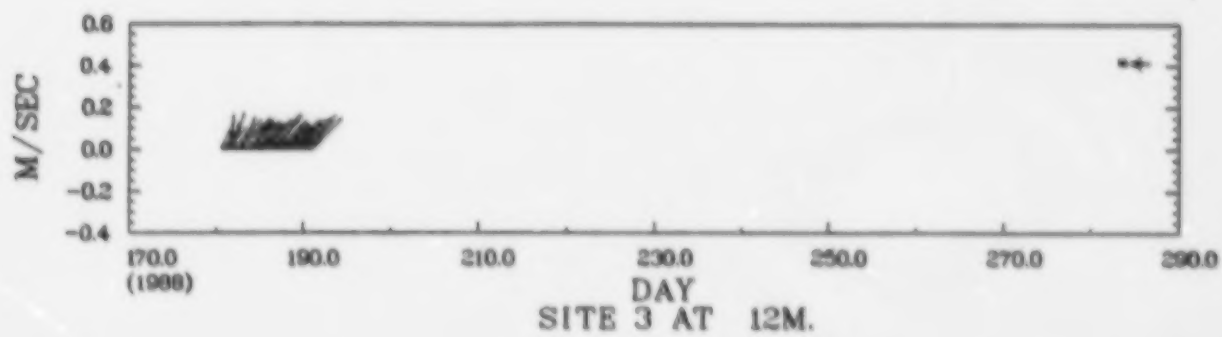
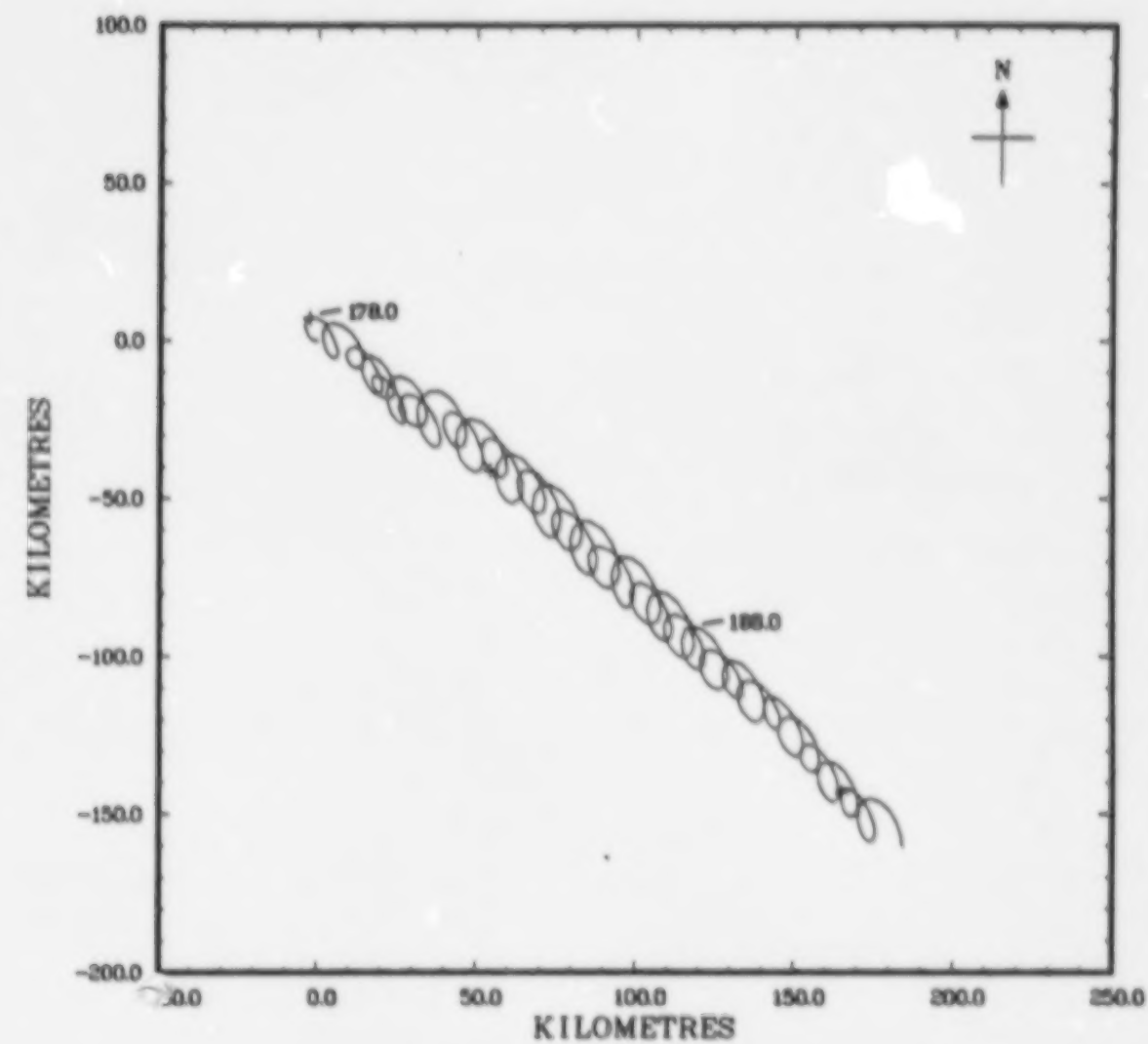
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 12 M.



SITE 3 AT 12 M.



STATISTICS

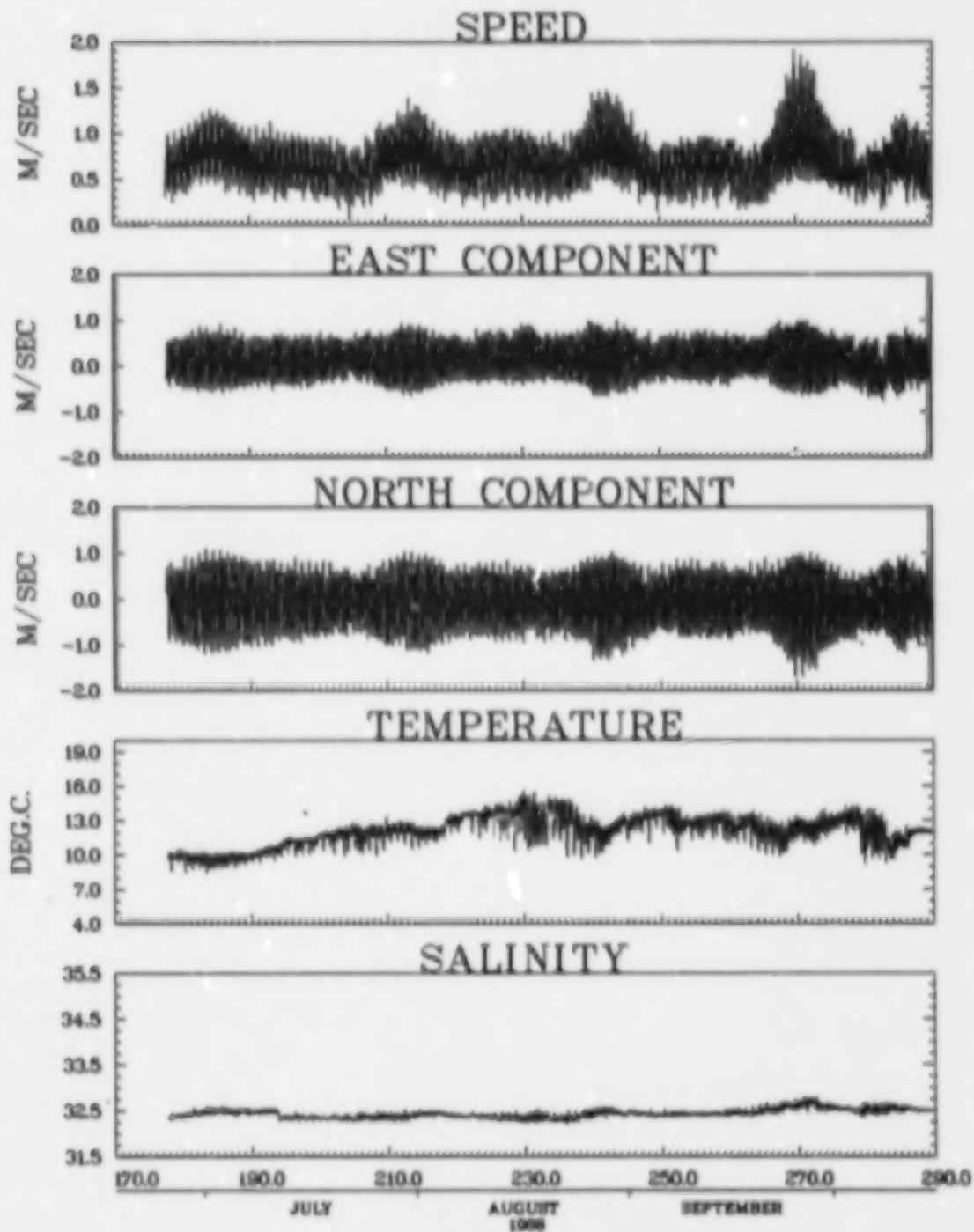
Site 3 at 34 m, 1988

(Moorings 893, 913)

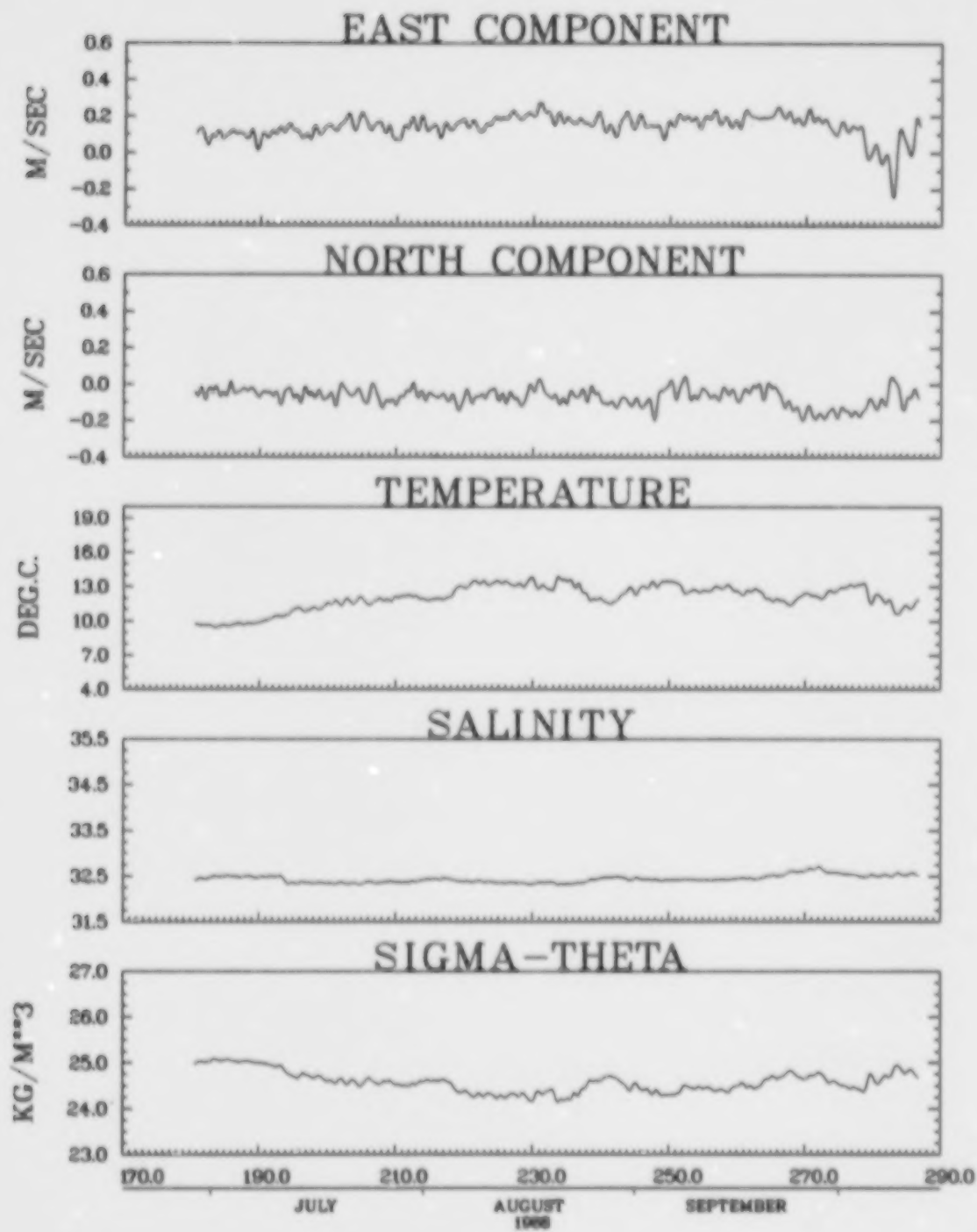
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2683	125	744	744	720	350
$\bar{X}$	0.142	0.098	0.125	0.171	0.177	0.058
Σ_1	0.413	0.393	0.396	0.422	0.418	0.410
Σ_6	0.065	0.033	0.038	0.038	0.035	0.105
North Velocity Component (m.s^{-1})						
N	2683	125	744	744	720	350
$\bar{X}$	-0.069	-0.059	-0.054	-0.068	-0.077	-0.090
Σ_1	0.599	0.631	0.612	0.597	0.607	0.543
Σ_6	0.047	0.025	0.031	0.033	0.061	0.059
Temperature ($^{\circ}\text{C}$)						
N	2683	125	744	744	720	350
$\bar{X}$	12.01	9.76	11.01	12.79	12.59	12.08
Σ_1	1.36	0.45	1.06	1.16	0.89	1.09
Σ_6	1.11	0.05	0.93	0.66	0.51	0.85
Salinity (PSS78)						
N	2683	125	744	744	720	350
$\bar{X}$	32.44	32.42	32.41	32.39	32.49	32.53
Σ_1	0.09	0.05	0.08	0.07	0.10	0.06
Σ_6	0.08	0.02	0.07	0.05	0.08	0.02
Sigma-theta (kg.m^{-3})						
N	2683	125	744	744	720	350
$\bar{X}$	24.59	24.97	24.75	24.41	24.53	24.65
Σ_1	0.29	0.10	0.24	0.27	0.23	0.24
Σ_6	0.23	0.02	0.21	0.16	0.15	0.17

N: number of samples in statistics

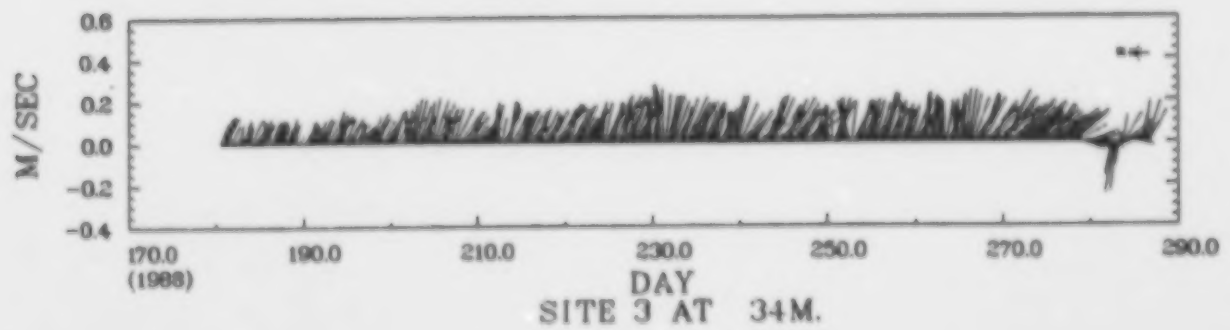
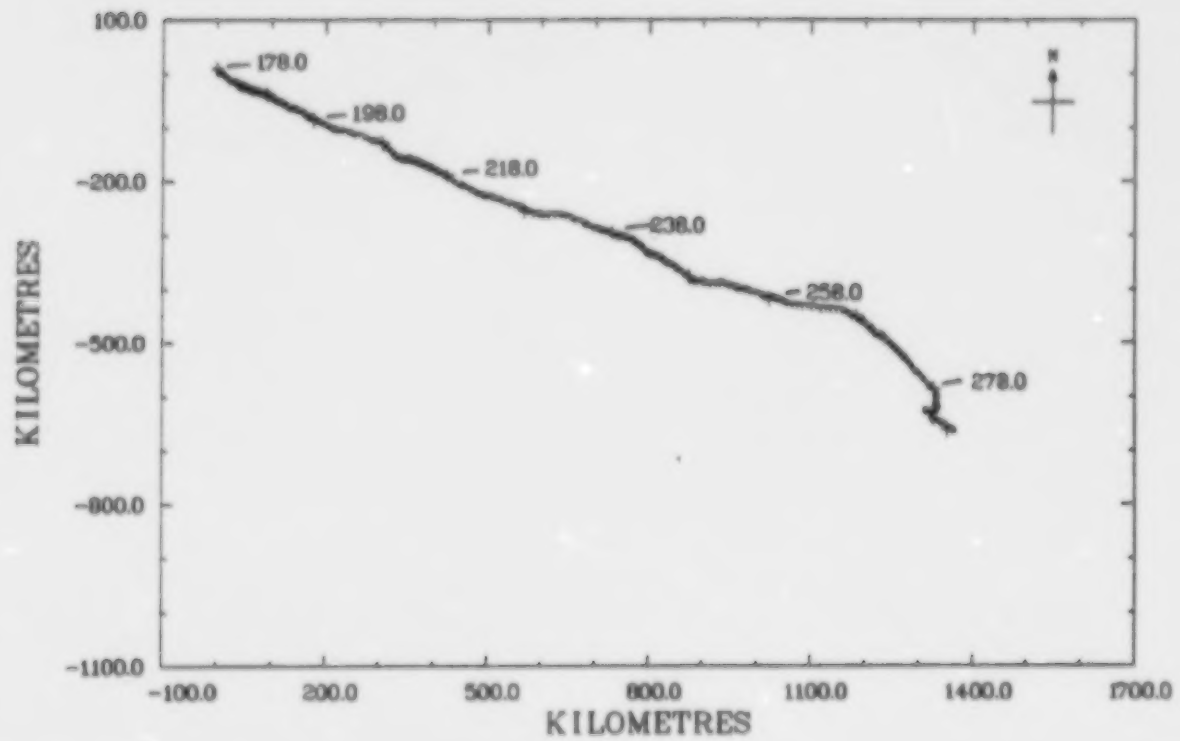
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 34 M.



SITE 3 AT 34 M.



STATISTICS

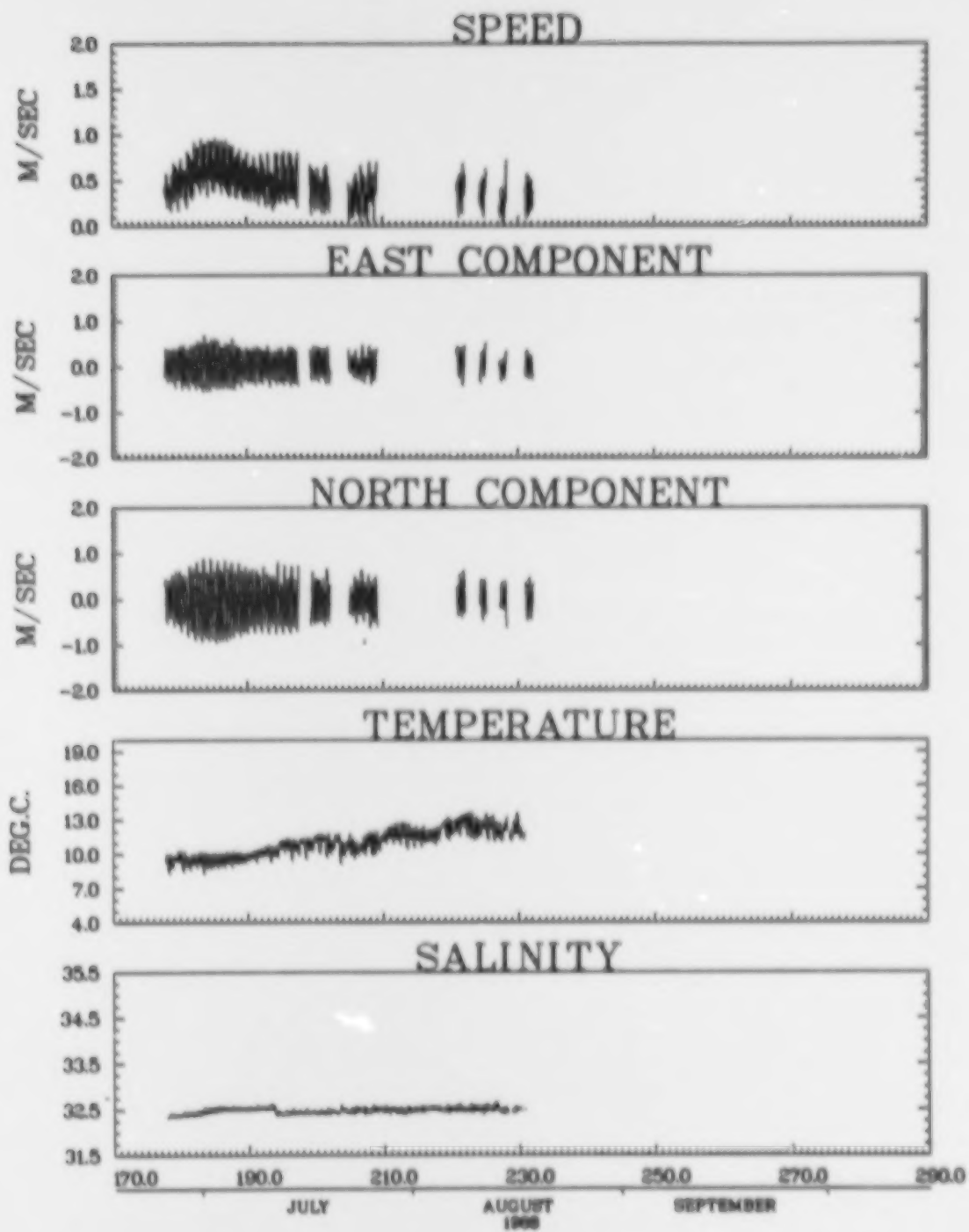
Site 3 at 57 m, 1988

(Moorings 893, 913)

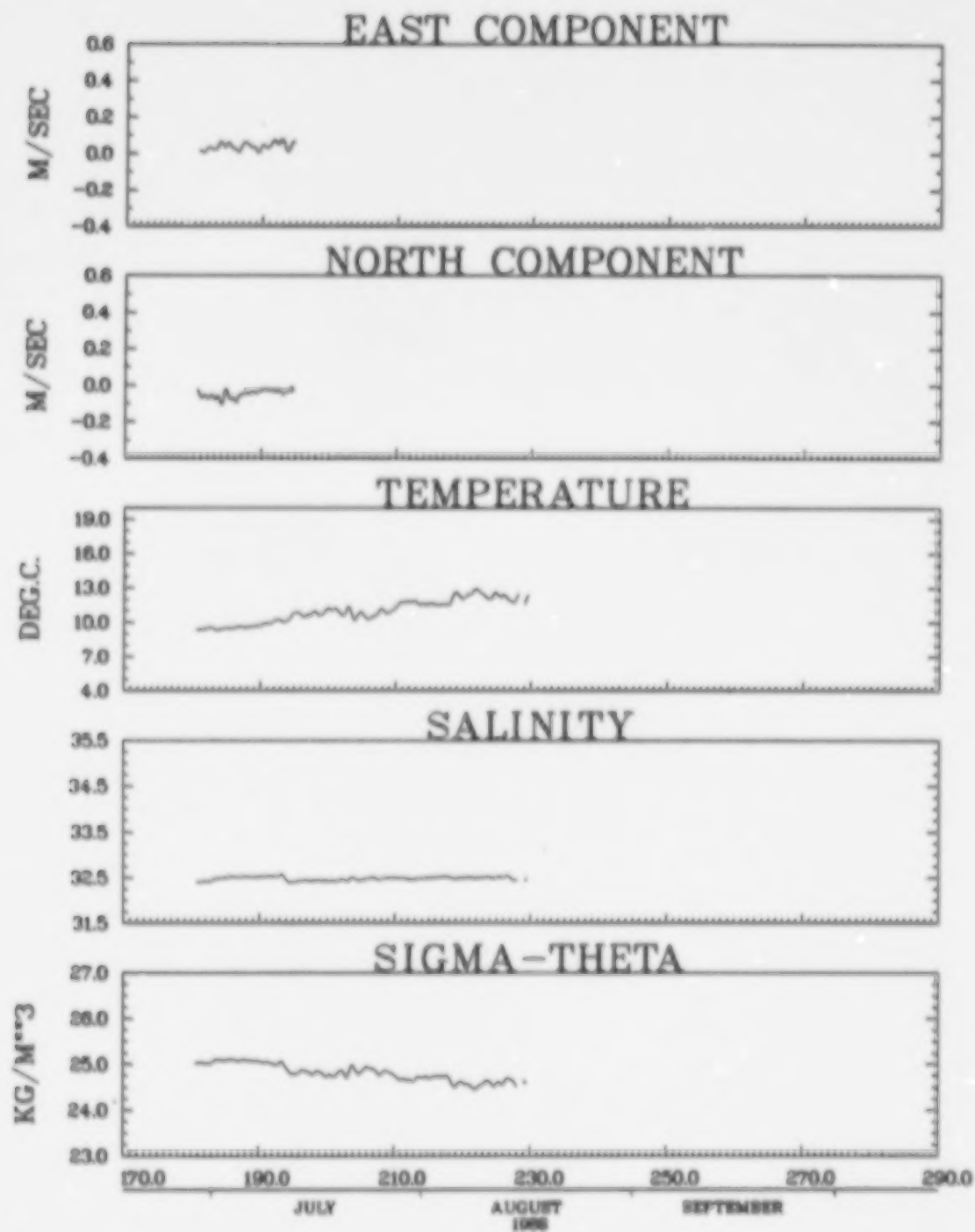
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	747	125	522	100		
$\bar{X}$	0.039	0.029	0.040	0.047		
Σ_1	0.271	0.286	0.278	0.215		
Σ_6	0.020	0.009	0.020			
North Velocity Component (m.s^{-1})						
N	747	125	522	100		
$\bar{X}$	-0.024	-0.035	-0.029	0.014		
Σ_1	0.434	0.446	0.452	0.307		
Σ_6	0.023	0.016	0.024			
Temperature ($^{\circ}\text{C}$)						
N	1254	125	744	385		
$\bar{X}$	10.90	9.45	10.53	12.10		
Σ_1	1.16	0.48	0.87	0.68		
Σ_6	1.02	0.08	0.73	0.42		
Salinity (PSS78)						
N	1243	125	744	374		
$\bar{X}$	32.48	32.40	32.48	32.50		
Σ_1	0.06	0.04	0.05	0.04		
Σ_6	0.04	0.01	0.04	0.02		
Sigma-theta (kg.m^{-3})						
N	1243	125	744	374		
$\bar{X}$	24.83	25.01	24.90	24.62		
Σ_1	0.21	0.10	0.18	0.14		
Σ_6	0.18	0.01	0.14	0.08		

N: number of samples in statistics

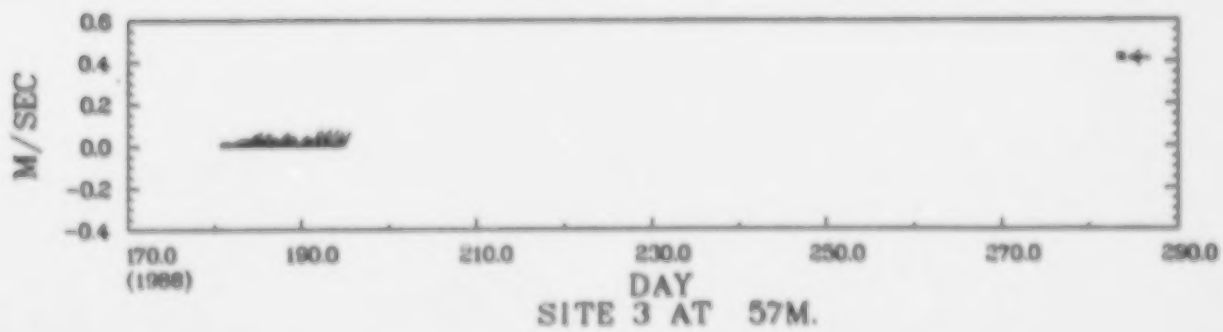
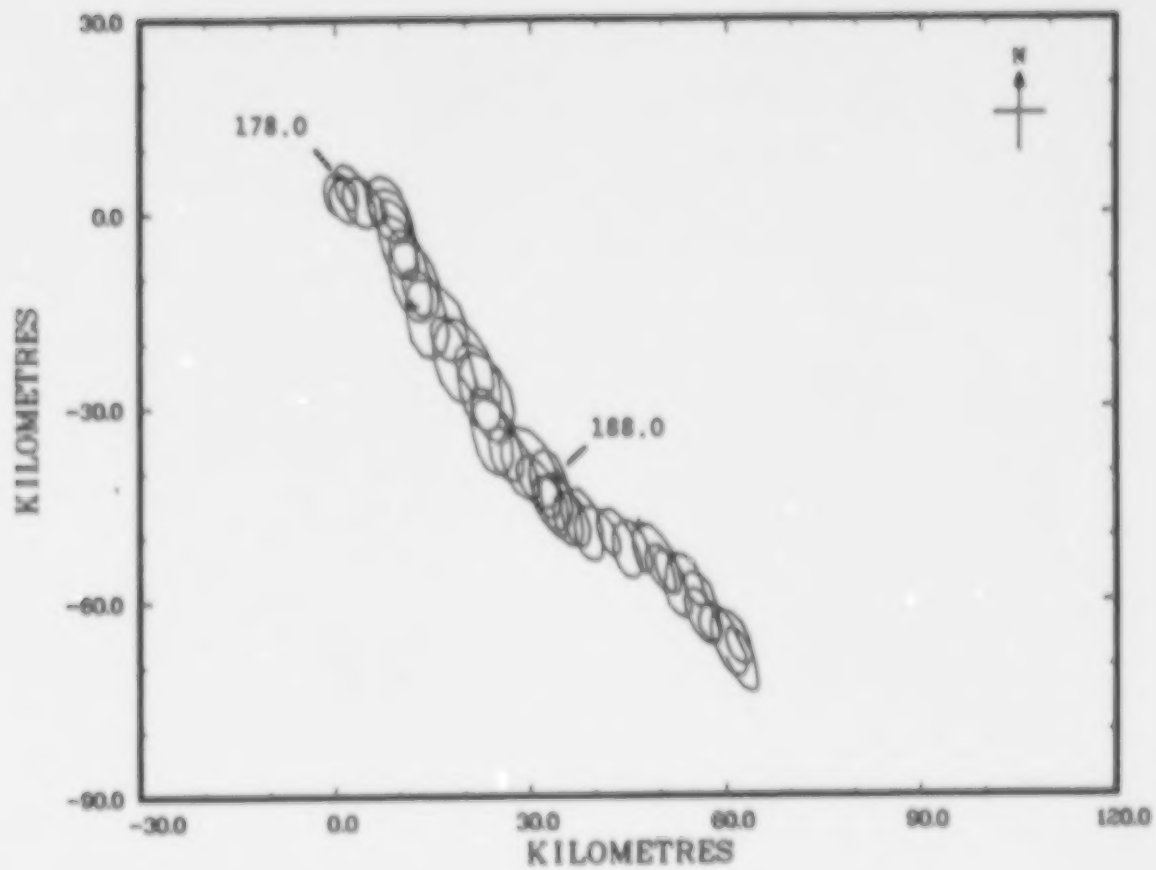
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 57 M.



SITE 3 AT 57 M.



STATISTICS

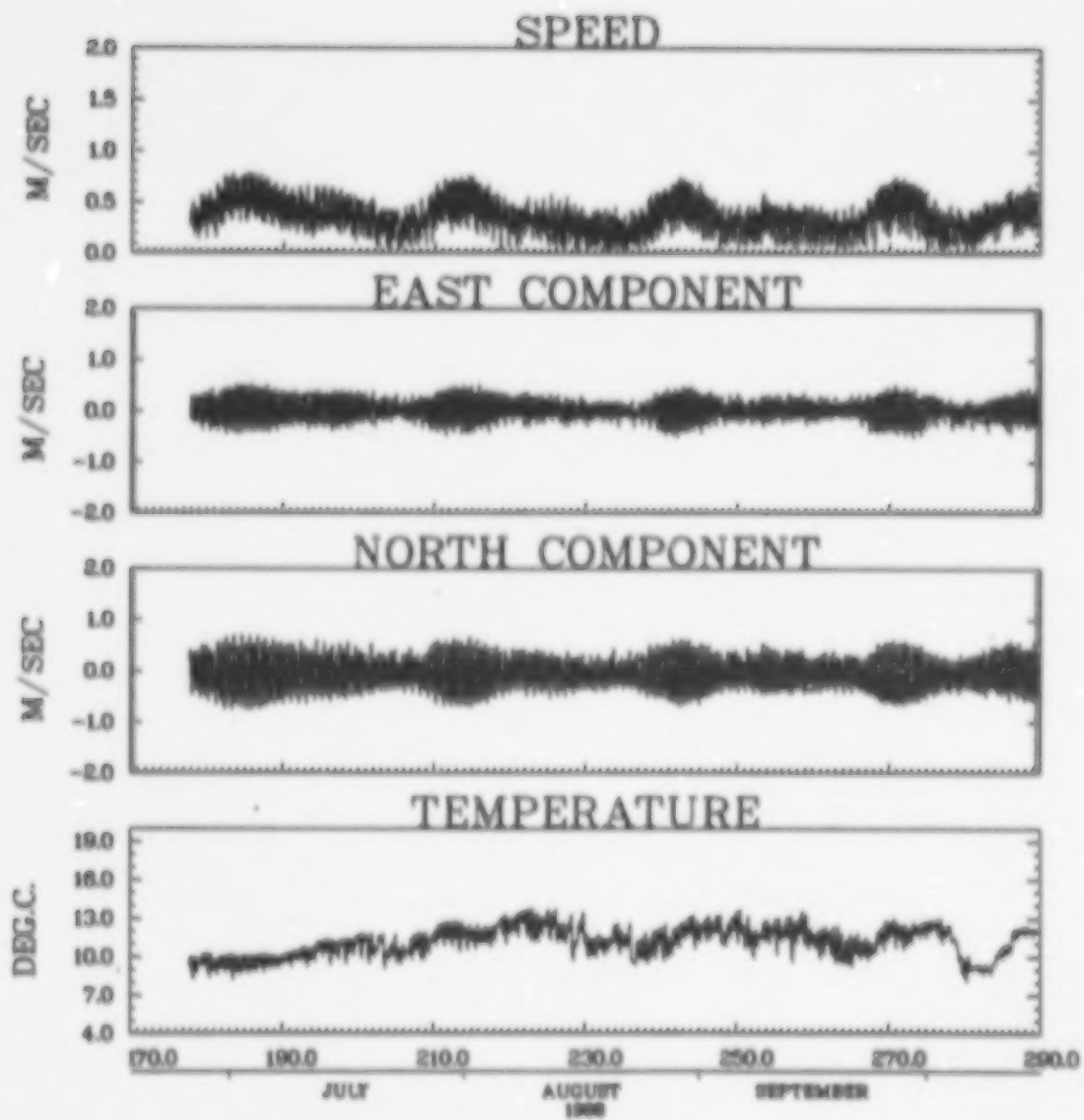
Site 3 at 64 m, 1988

(Moorings 893, 913)

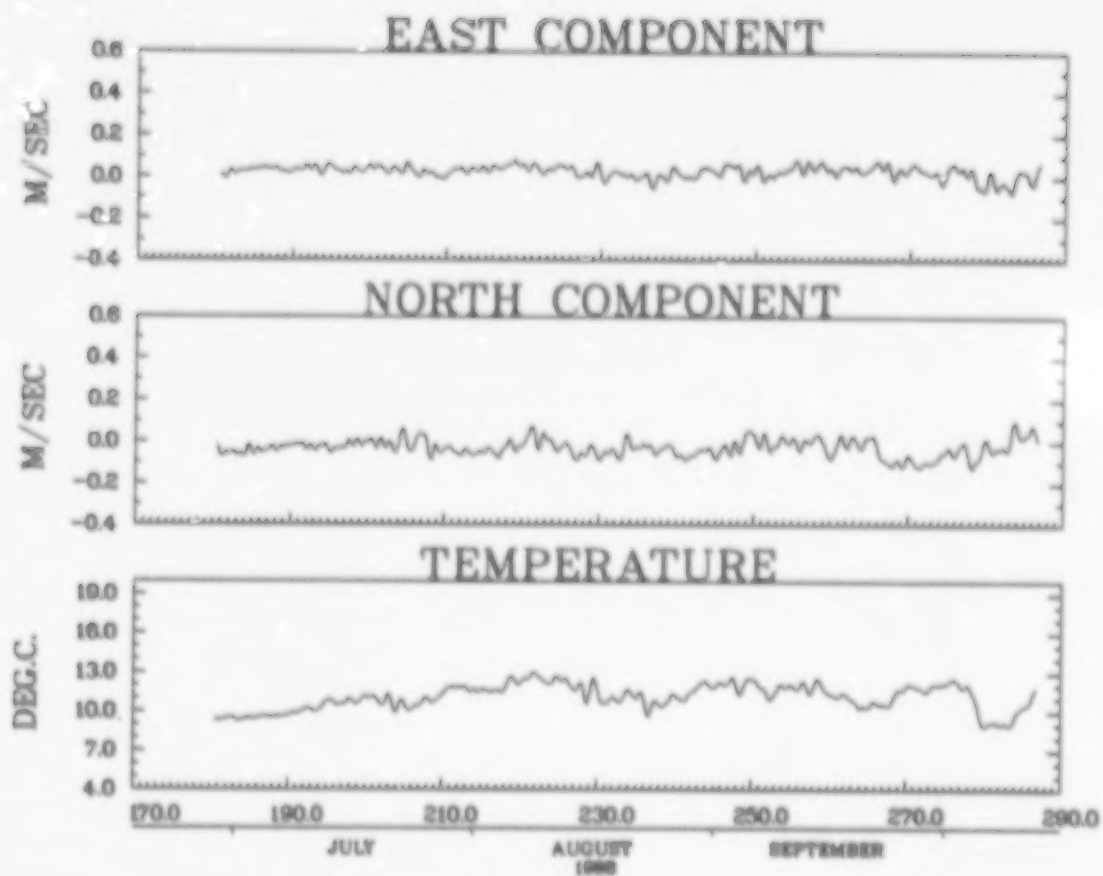
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2683	125	744	744	720	350
$\bar{X}$	0.028	0.020	0.033	0.026	0.035	0.010
Σ_1	0.215	0.240	0.237	0.203	0.206	0.200
Σ_6	0.028	0.012	0.016	0.026	0.025	0.043
North Velocity Component (m.s^{-1})						
N	2683	125	744	744	720	350
$\bar{X}$	-0.028	-0.035	-0.027	-0.034	-0.030	-0.014
Σ_1	0.334	0.377	0.372	0.318	0.314	0.305
Σ_6	0.040	0.016	0.027	0.033	0.050	0.054
Temperature ($^{\circ}\text{C}$)						
N	2683	125	744	744	720	350
$\bar{X}$	11.10	9.43	10.49	11.62	11.61	10.80
Σ_1	1.14	0.48	0.88	0.94	0.88	1.34
Σ_6	0.99	0.09	0.73	0.73	0.62	1.31

N: number of samples in statistics

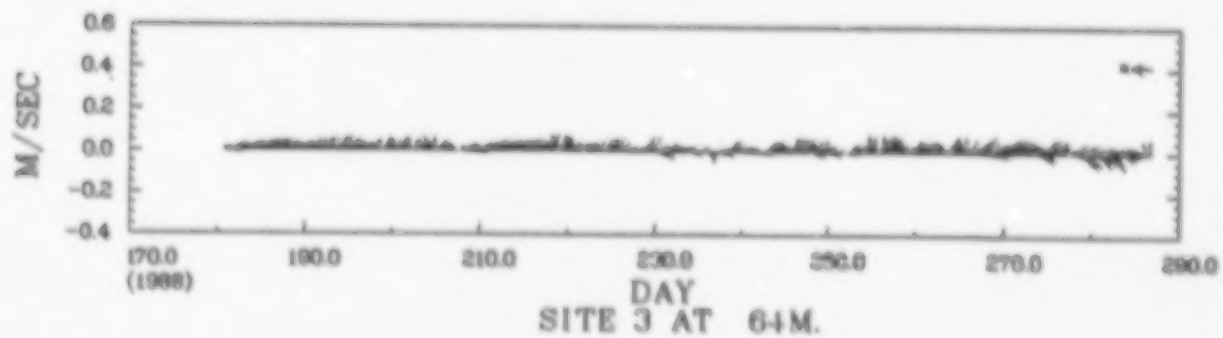
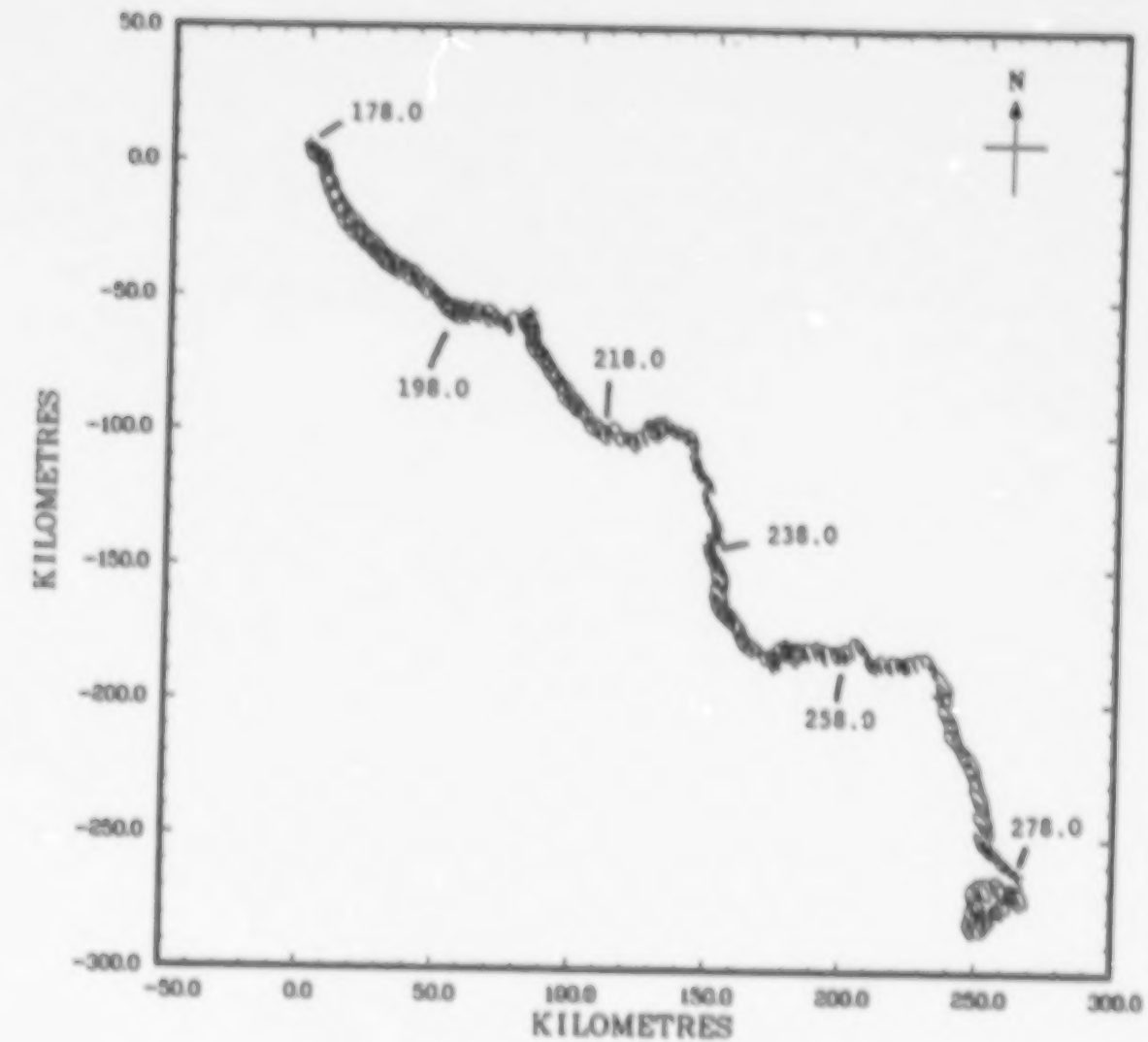
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 64 M.



SITE 3 AT 64 M.



STATISTICS
Site 4 at 11 m, 1988
(Mooring 895)

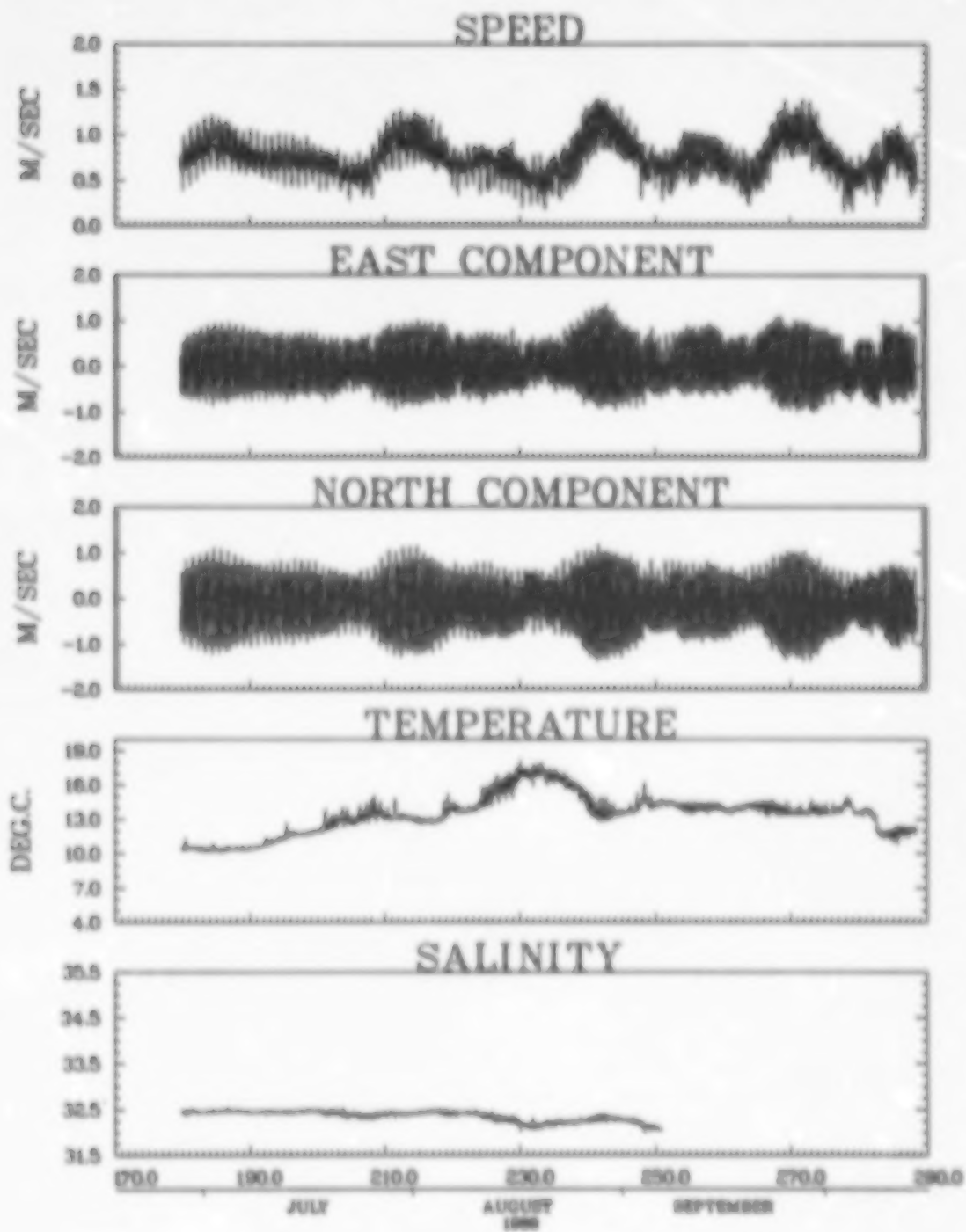
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component ($m.s^{-1}$)						
N	2612	79	744	744	720	325
$\bar{X}$	0.020	-0.027	0.007	0.037	0.044	-0.035
Σ_1	0.511	0.499	0.496	0.521	0.526	0.485
Σ_6	0.074	0.011	0.033	0.065	0.070	0.131
North Velocity Component ($m.s^{-1}$)						
N	2612	79	744	744	720	325
$\bar{X}$	-0.106	-0.133	-0.100	-0.097	-0.114	-0.117
Σ_1	0.596	0.634	0.611	0.609	0.605	0.500
Σ_6	0.051	0.013	0.029	0.052	0.063	0.060
Temperature ($^{\circ}C$)						
N	2612	79	744	744	720	325
$\bar{X}$	13.41	10.48	11.91	14.86	14.00	12.93
Σ_1	1.70	0.17	1.23	1.54	0.40	1.01
Σ_6	1.63	0.01	1.20	1.48	0.29	0.98
Salinity (PSS78)						
N	1710	79	744	744	143	
$\bar{X}$	32.36	32.45	32.43	32.31	32.18	
Σ_1	0.11	0.03	0.04	0.11	0.08	
Σ_6	0.11	0.00	0.04	0.10	0.08	
Sigma-theta ($kg.m^{-3}$)						
N	1710	79	744	744	143	
$\bar{X}$	24.27	24.89	24.61	23.92	23.97	
Σ_1	0.48	0.04	0.25	0.40	0.16	
Σ_6	0.46	0.00	0.24	0.39	0.14	

N: number of samples in statistics

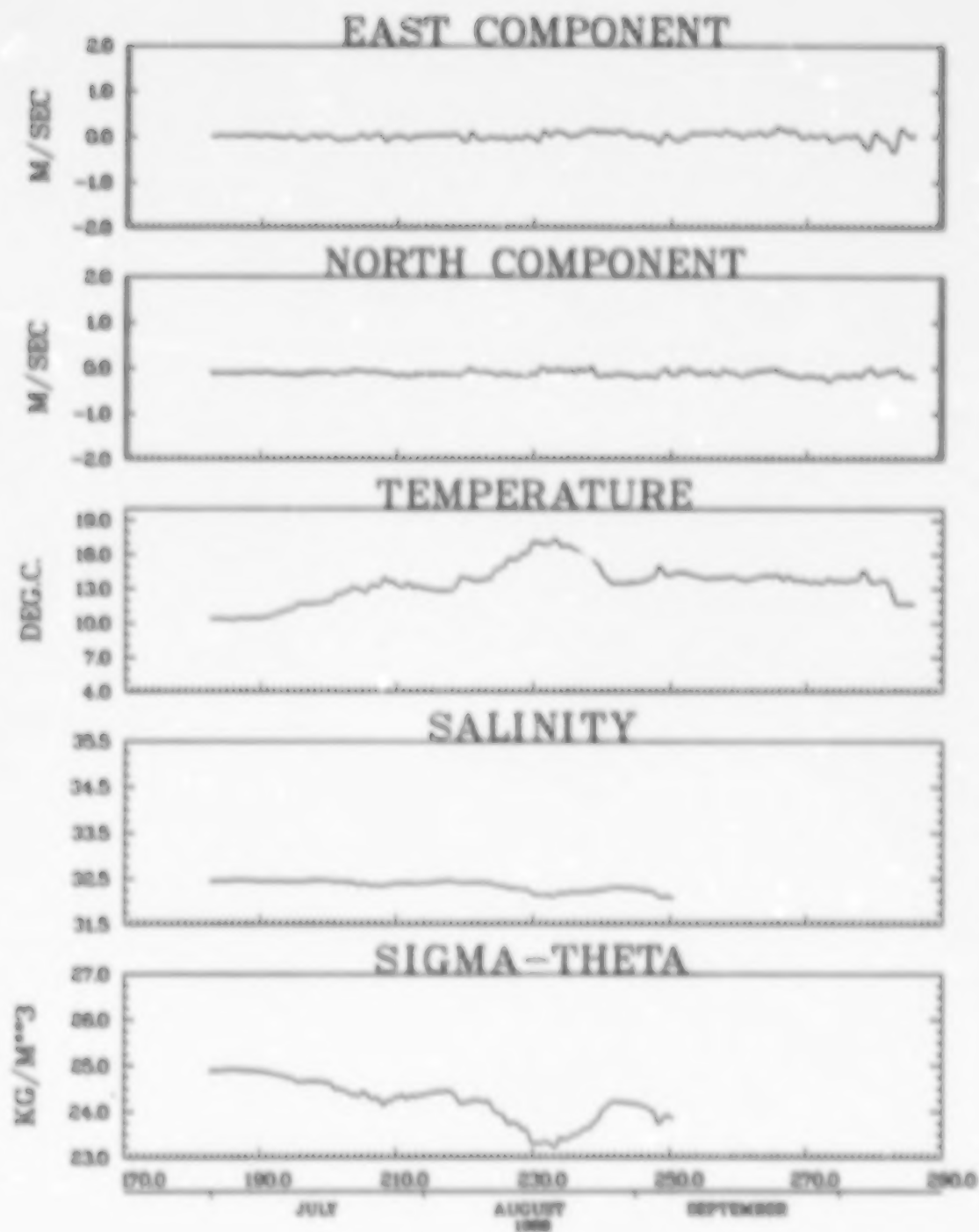
$\bar{X}$: mean value

Σ_1 : standard deviation of 1-hr time series

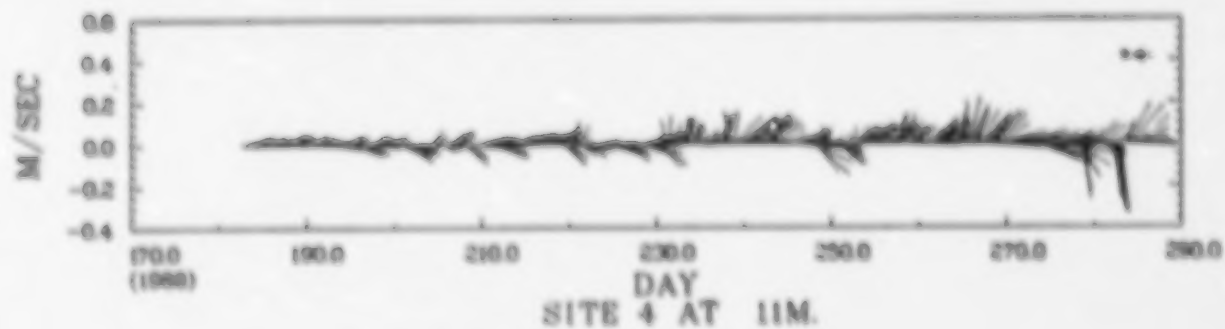
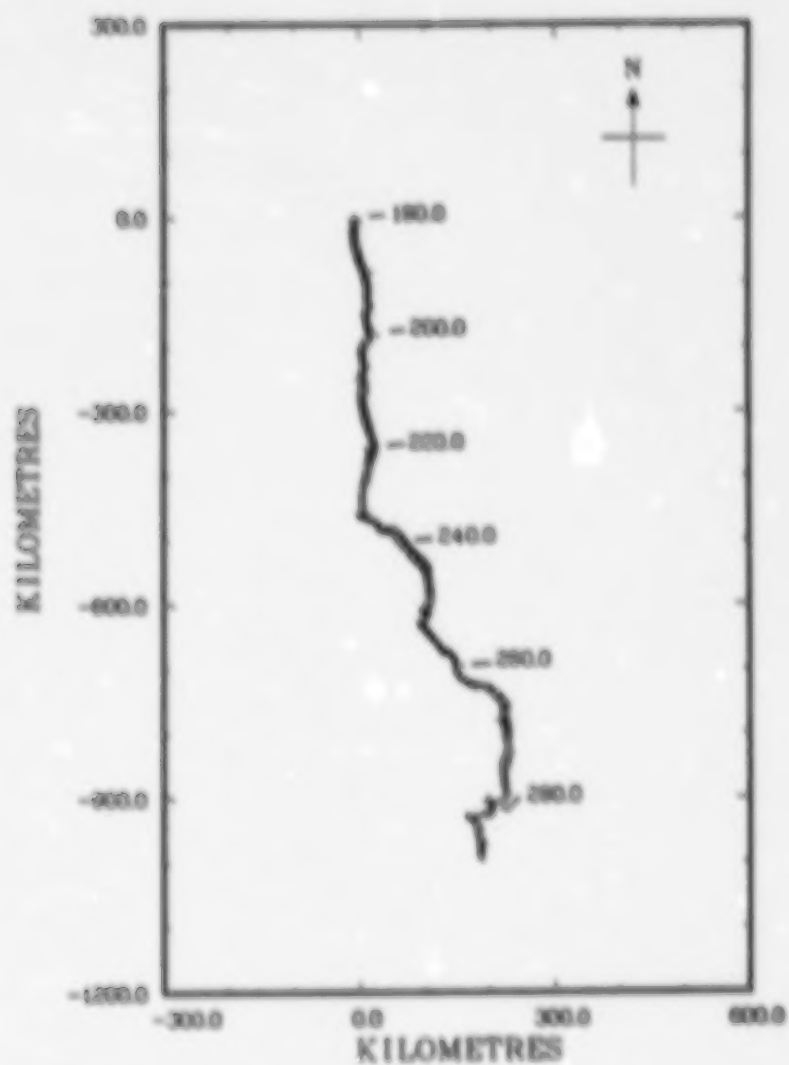
Σ_6 : standard deviation of 6-hr time series



SITE 4 AT 11 M.



SITE 4 AT 11 M.



STATISTICS

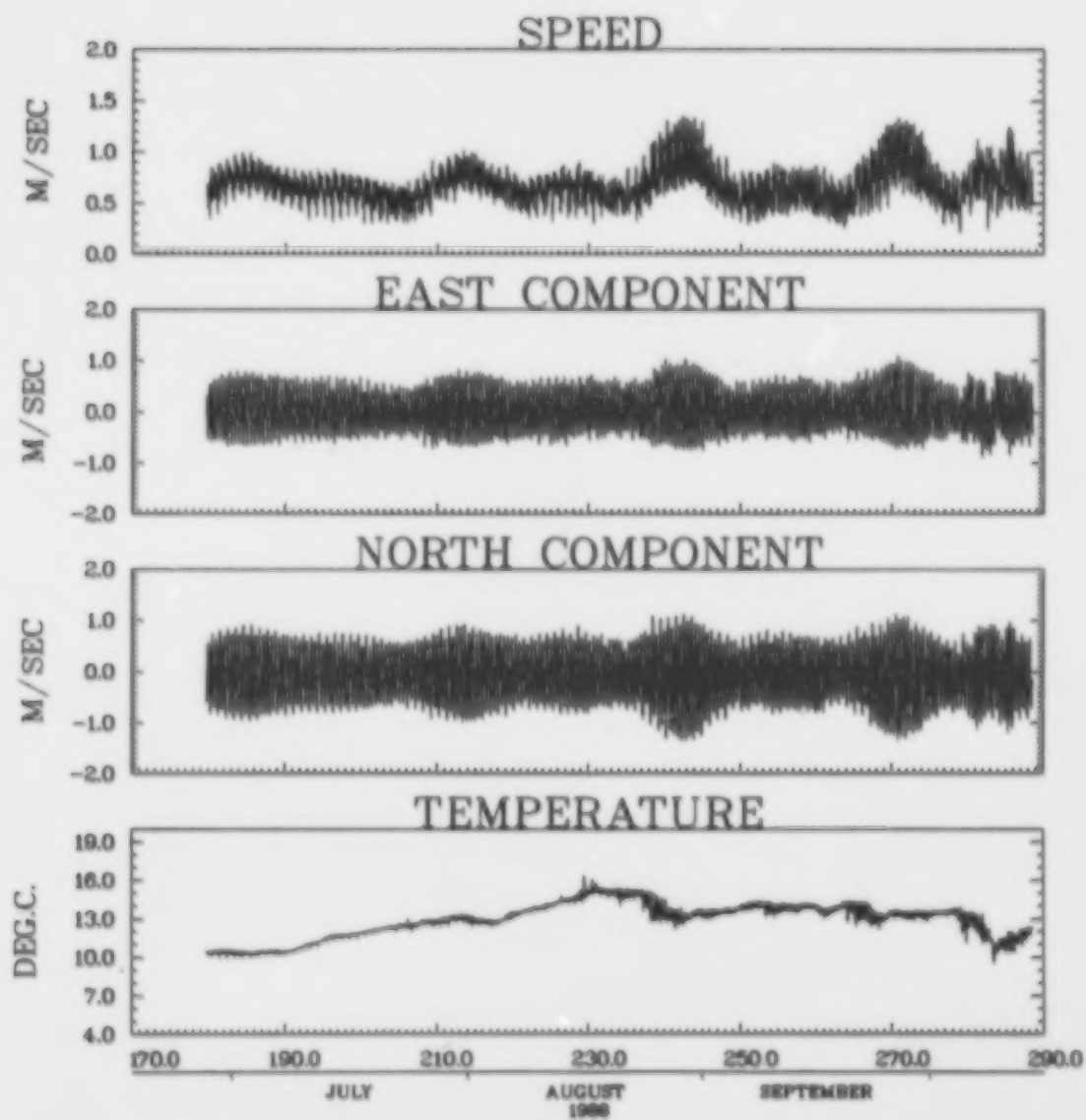
Site 4 at 34 m, 1988

(Mooring 895)

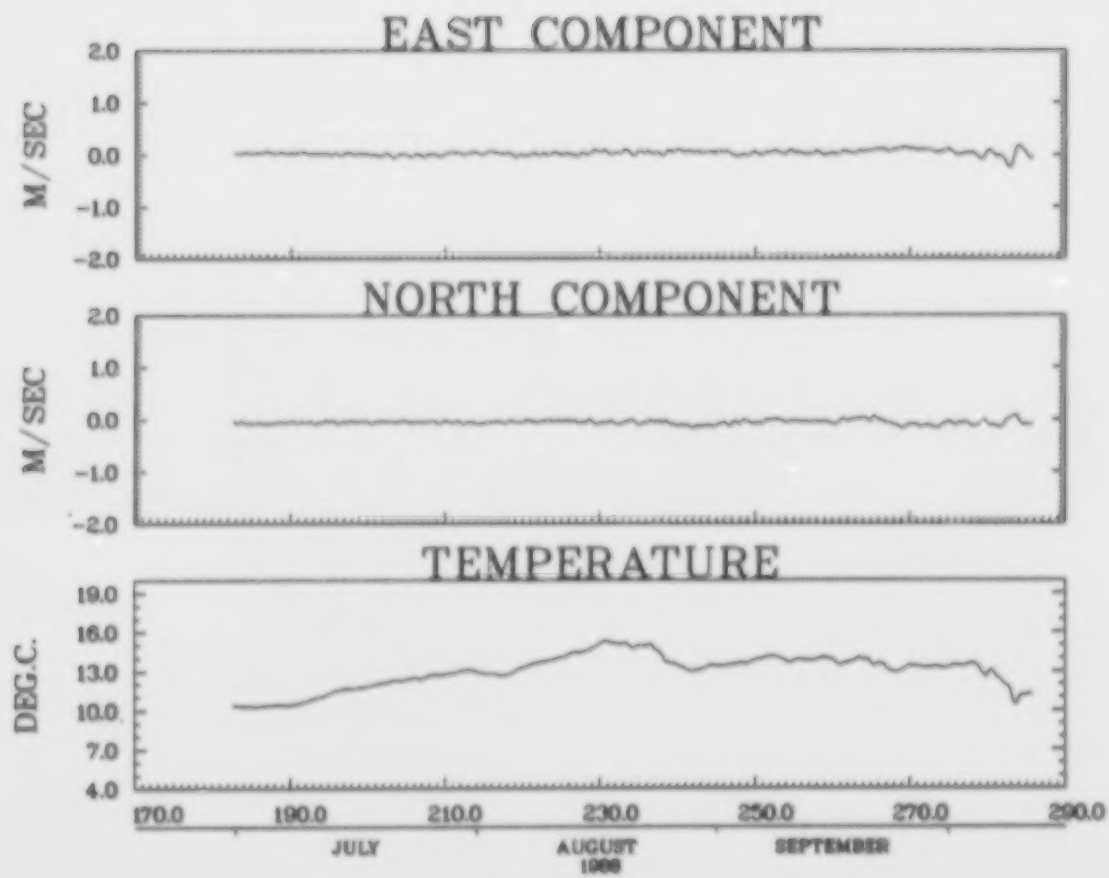
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2612	79	744	744	720	325
$\bar{X}$	0.030	0.005	0.018	0.034	0.054	0.003
Σ_1	0.428	0.440	0.412	0.438	0.433	0.432
Σ_6	0.046	0.004	0.024	0.031	0.039	0.092
North Velocity Component (m.s^{-1})						
N	2612	79	744	744	720	325
$\bar{X}$	-0.060	-0.062	-0.052	-0.063	-0.058	-0.074
Σ_1	0.567	0.554	0.535	0.587	0.580	0.568
Σ_6	0.041	0.000	0.018	0.038	0.050	0.059
Temperature ($^{\circ}\text{C}$)						
N	2612	79	744	744	720	325
$\bar{X}$	12.87	10.38	11.61	13.91	13.62	12.32
Σ_1	1.35	0.14	0.96	0.89	0.41	1.05
Σ_6	1.28	0.01	0.96	0.84	0.30	1.03

N: number of samples in statistics

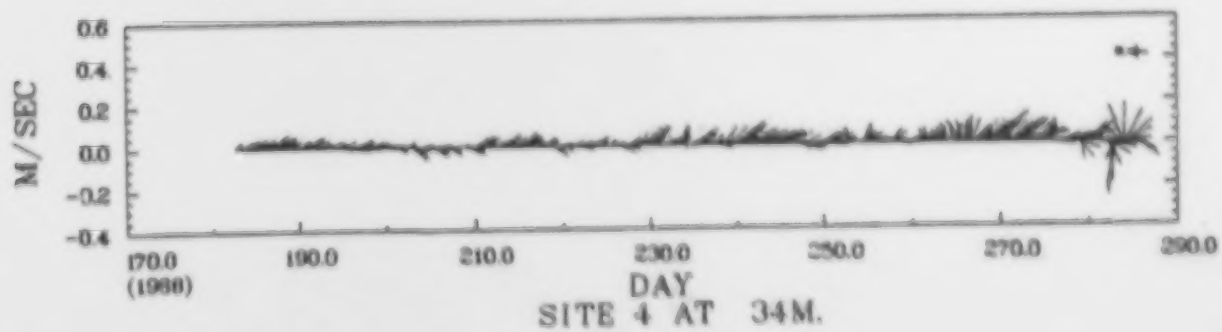
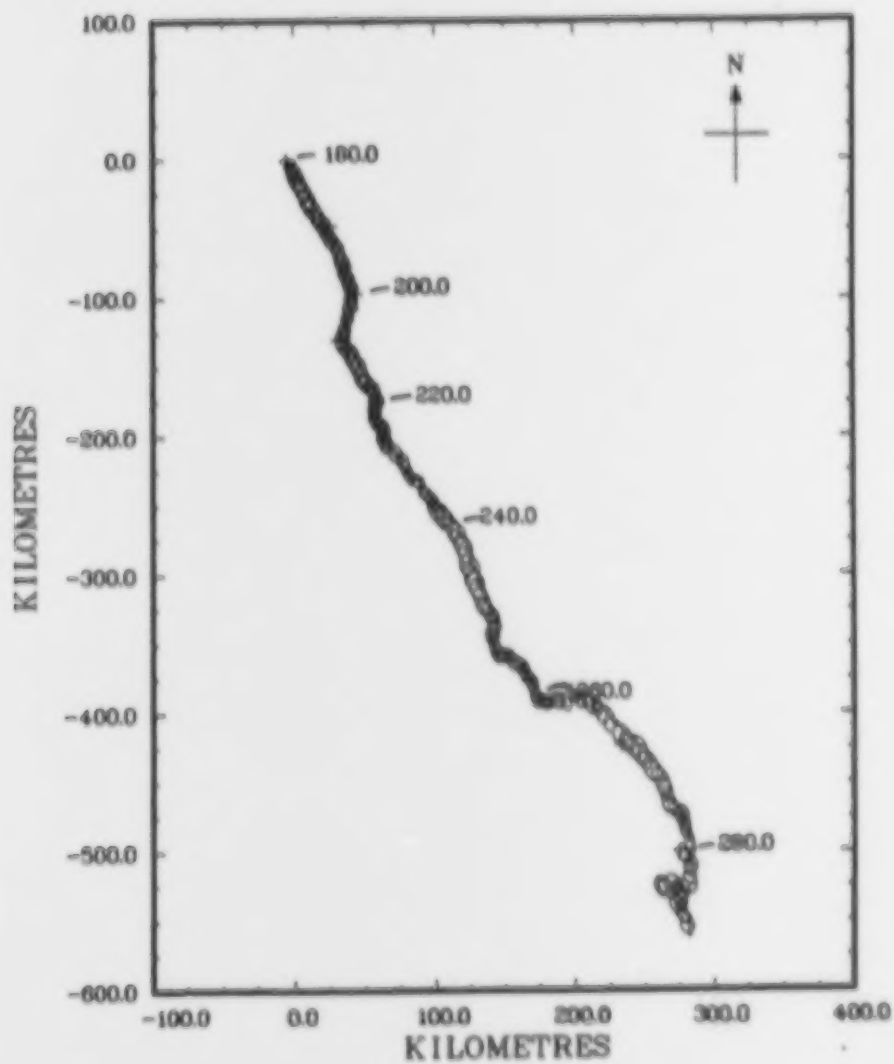
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 4 AT 34 M.



SITE 4 AT 34 M.



STATISTICS

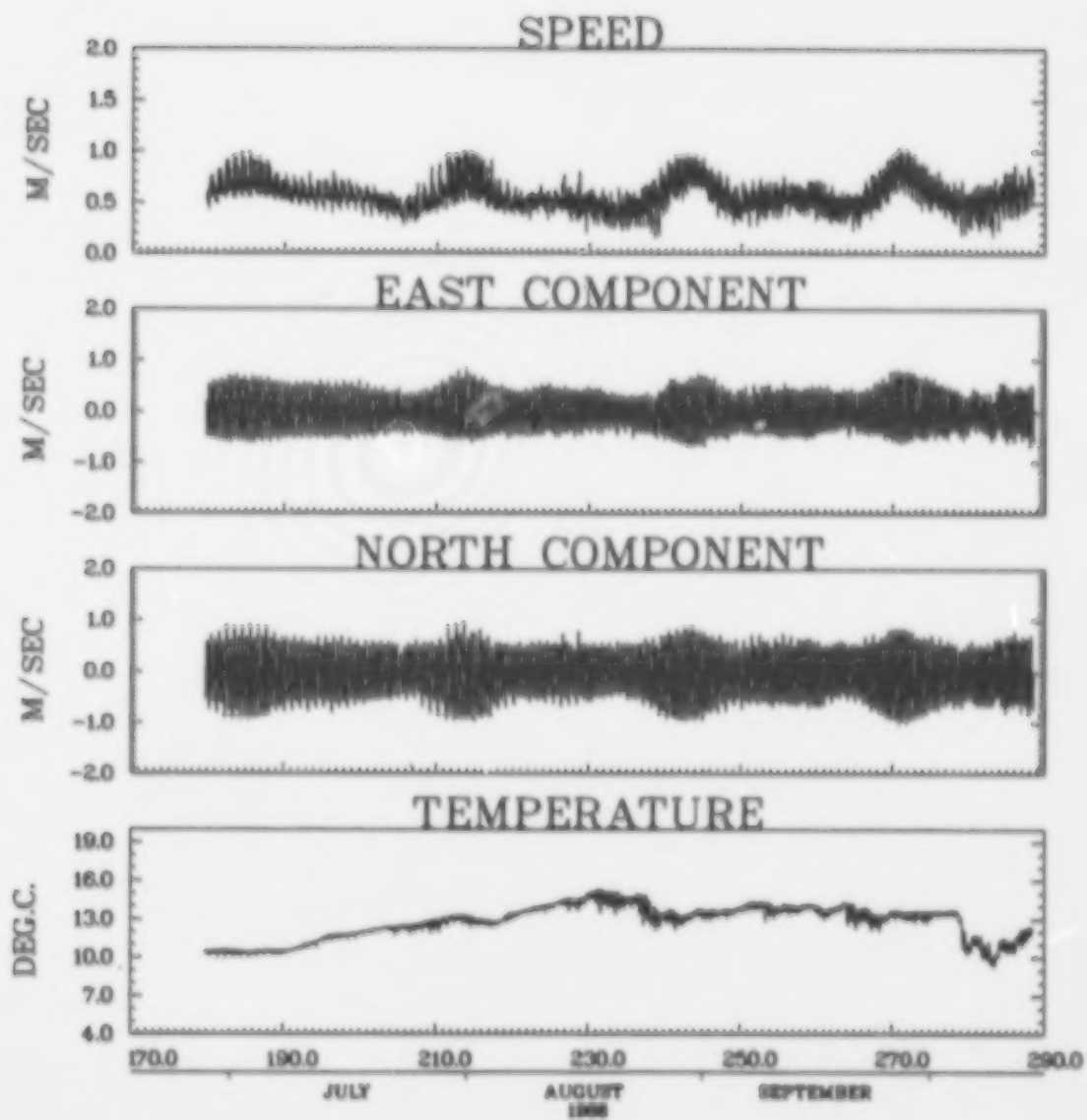
Site 4 at 53 m, 1988

(Mooring 895)

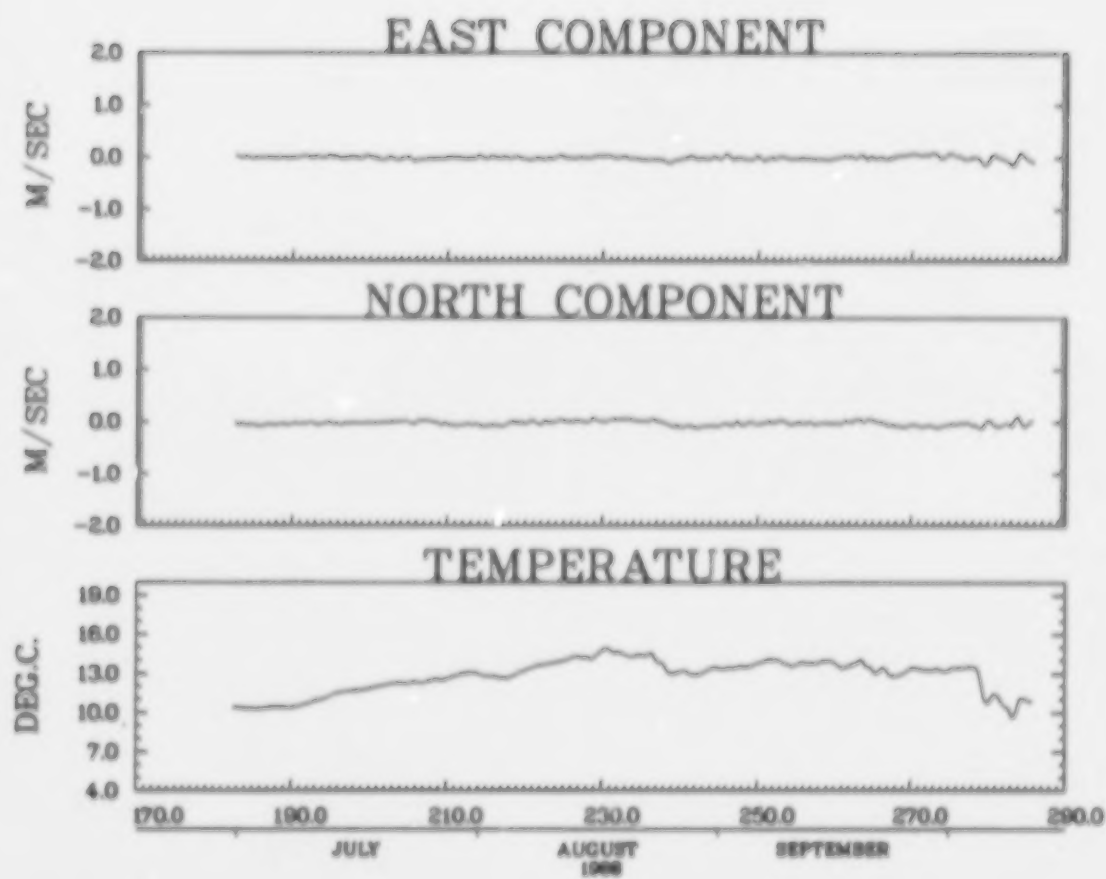
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	2612	79	744	744	720	325
$\bar{X}$	-0.005	-0.013	-0.006	-0.007	0.009	-0.023
Σ_1	0.354	0.414	0.372	0.337	0.355	0.329
Σ_6	0.034	0.015	0.020	0.026	0.034	0.063
North Velocity Component (m.s^{-1})						
N	2612	79	744	744	720	325
$\bar{X}$	-0.022	-0.031	-0.025	-0.010	-0.025	-0.031
Σ_1	0.486	0.524	0.492	0.476	0.496	0.464
Σ_6	0.041	0.002	0.026	0.049	0.038	0.049
Temperature ($^{\circ}\text{C}$)						
N	2612	79	744	744	720	325
$\bar{X}$	12.72	10.40	11.60	13.70	13.56	11.75
Σ_1	1.32	0.14	0.93	0.74	0.42	1.26
Σ_6	1.26	0.01	0.92	0.67	0.32	1.35

N: number of samples in statistics

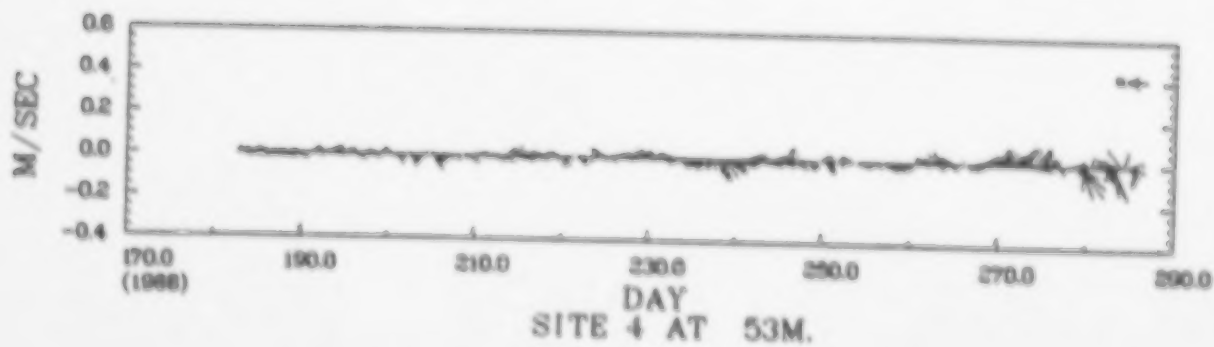
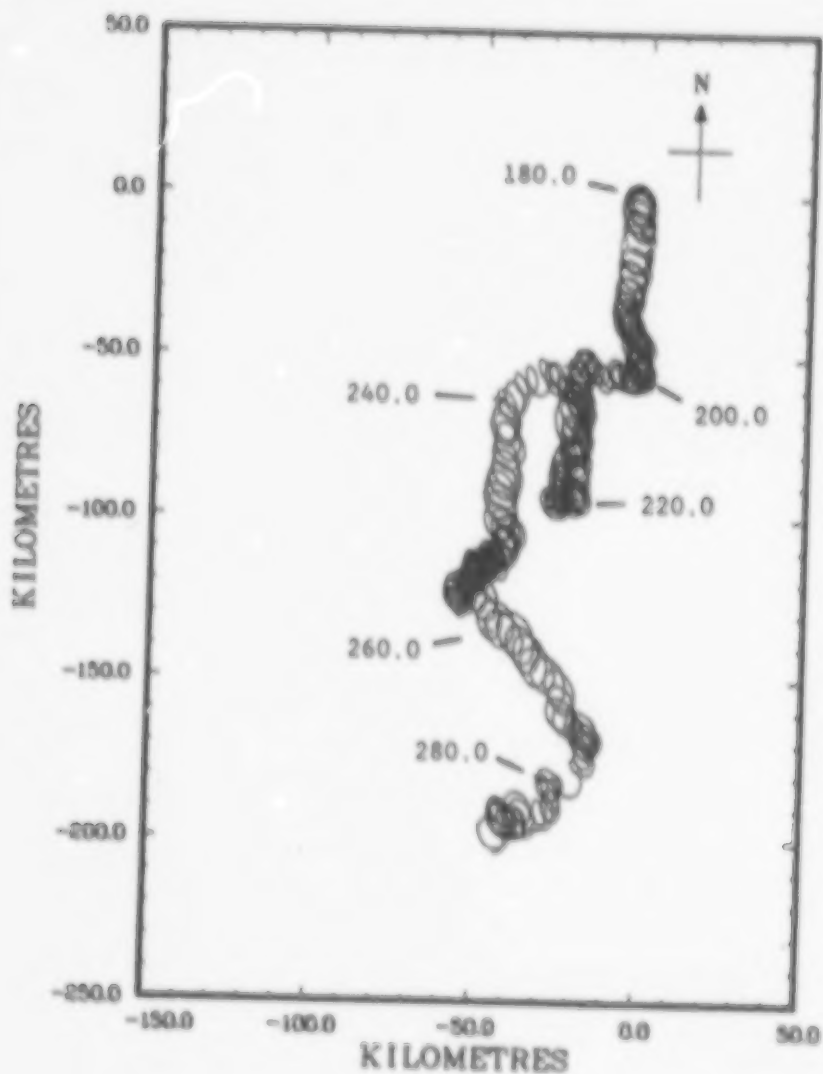
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 4 AT 53 M.



SITE 4 AT 53 M.



STATISTICS
Site 4 at 60 m, 1988
(Mooring 895)

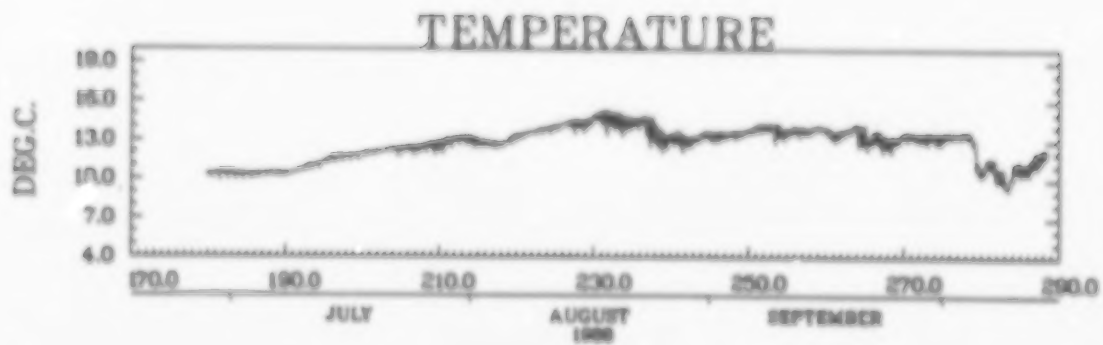
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
Temperature ($^{\circ}\text{C}$)						
N	2612	79	744	744	720	325
$\bar{X}$	12.66	10.36	11.56	13.64	13.50	11.67
Σ_1	1.33	0.14	0.93	0.74	0.43	1.28
Σ_6	1.26	0.01	0.92	0.67	0.33	1.38

N: number of samples in statistics

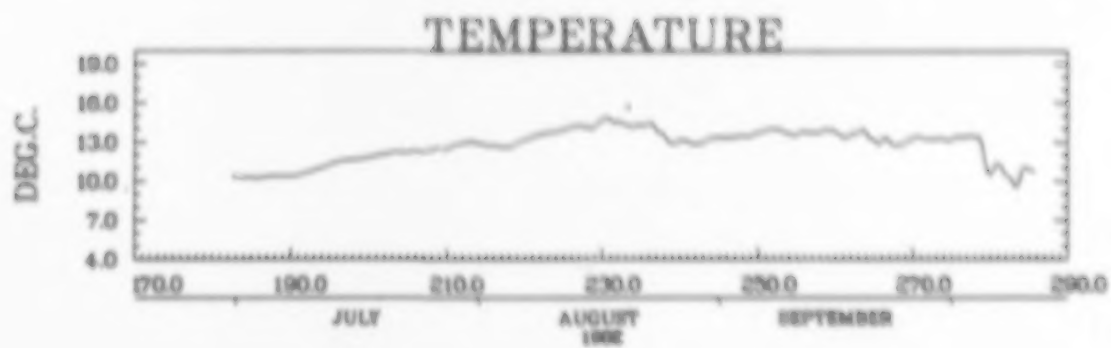
$\bar{X}$: mean value

Σ_1 : standard deviation of 1-hr time series

Σ_6 : standard deviation of 6-hr time series



SITE 4 AT 50 M.



SITE 4 AT 60 M.

NO PROGRESSIVE VECTOR AND STICK PLOTS
FOR SITE 4 AT 60 PL.

STATISTICS

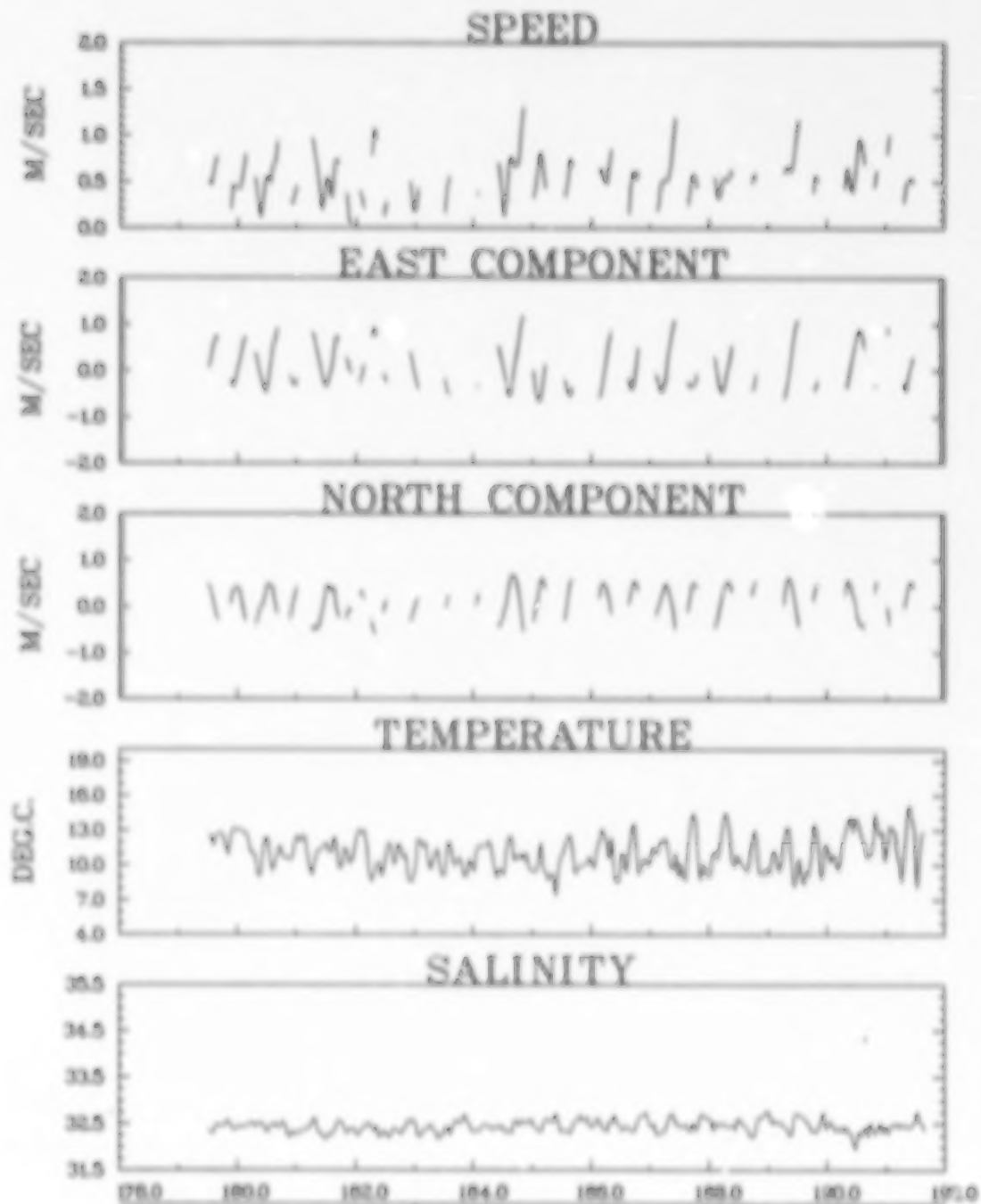
Site 5 at 10 m, 1988

(Mooring 896)

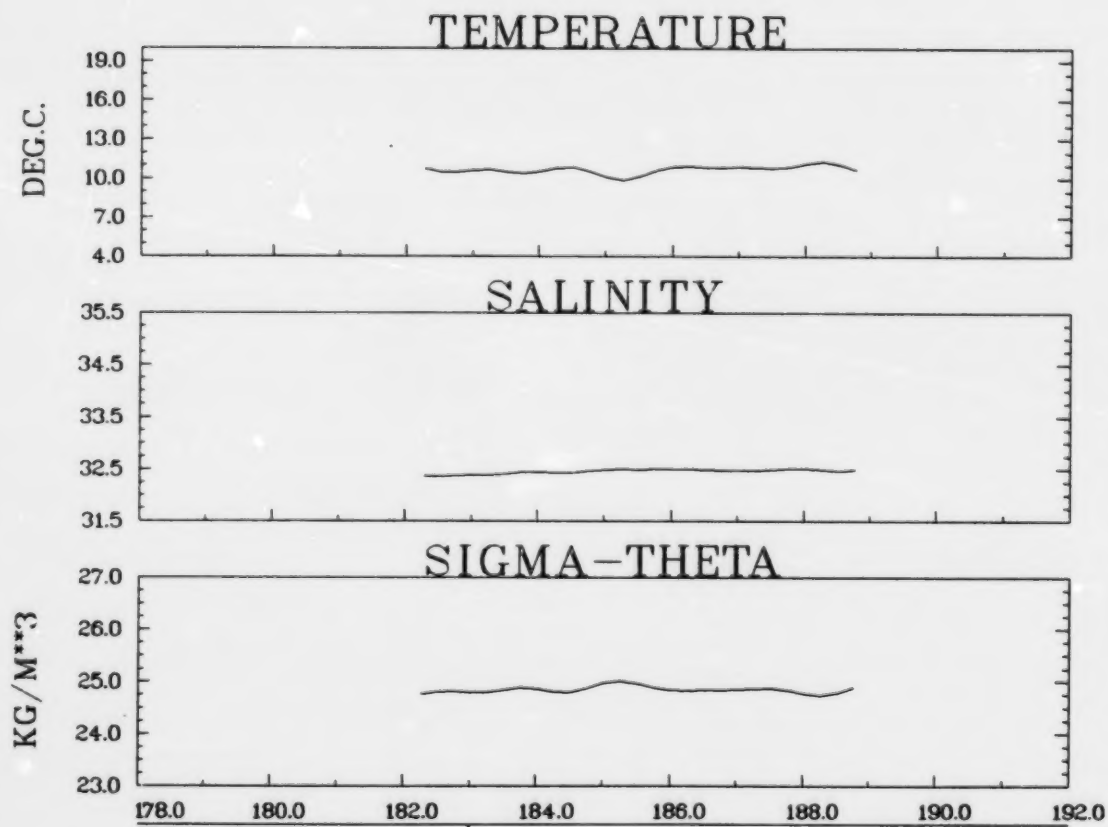
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	146	51	95			
$\bar{X}$	0.084	0.200	0.021			
Σ_1	0.466	0.409	0.485			
Σ_6						
North Velocity Component (m.s^{-1})						
N	146	51	95			
$\bar{X}$	0.121	0.019	0.176			
Σ_1	0.338	0.320	0.335			
Σ_6						
Temperature ($^{\circ}\text{C}$)						
N	292	84	208			
$\bar{X}$	11.02	11.22	10.84			
Σ_1	1.47	1.26	1.54			
Σ_6	0.32	0.16	0.34			
Salinity (PSS78)						
N	292	84	208			
$\bar{X}$	32.44	32.40	32.46			
Σ_1	0.13	0.10	0.13			
Σ_6	0.05	0.01	0.04			
Sigma-theta (kg.m^{-3})						
N	292	84	208			
$\bar{X}$	24.77	24.71	24.80			
Σ_1	0.32	0.26	0.34			
Σ_6	0.06	0.03	0.06			

N: number of samples in statistics

 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 5 AT 10 M.



SITE 5 AT 10 M.

NO PROGRESSIVE VECTOR AND STICK PLOTS
FOR SITE 5 AT 10 M.

STATISTICS

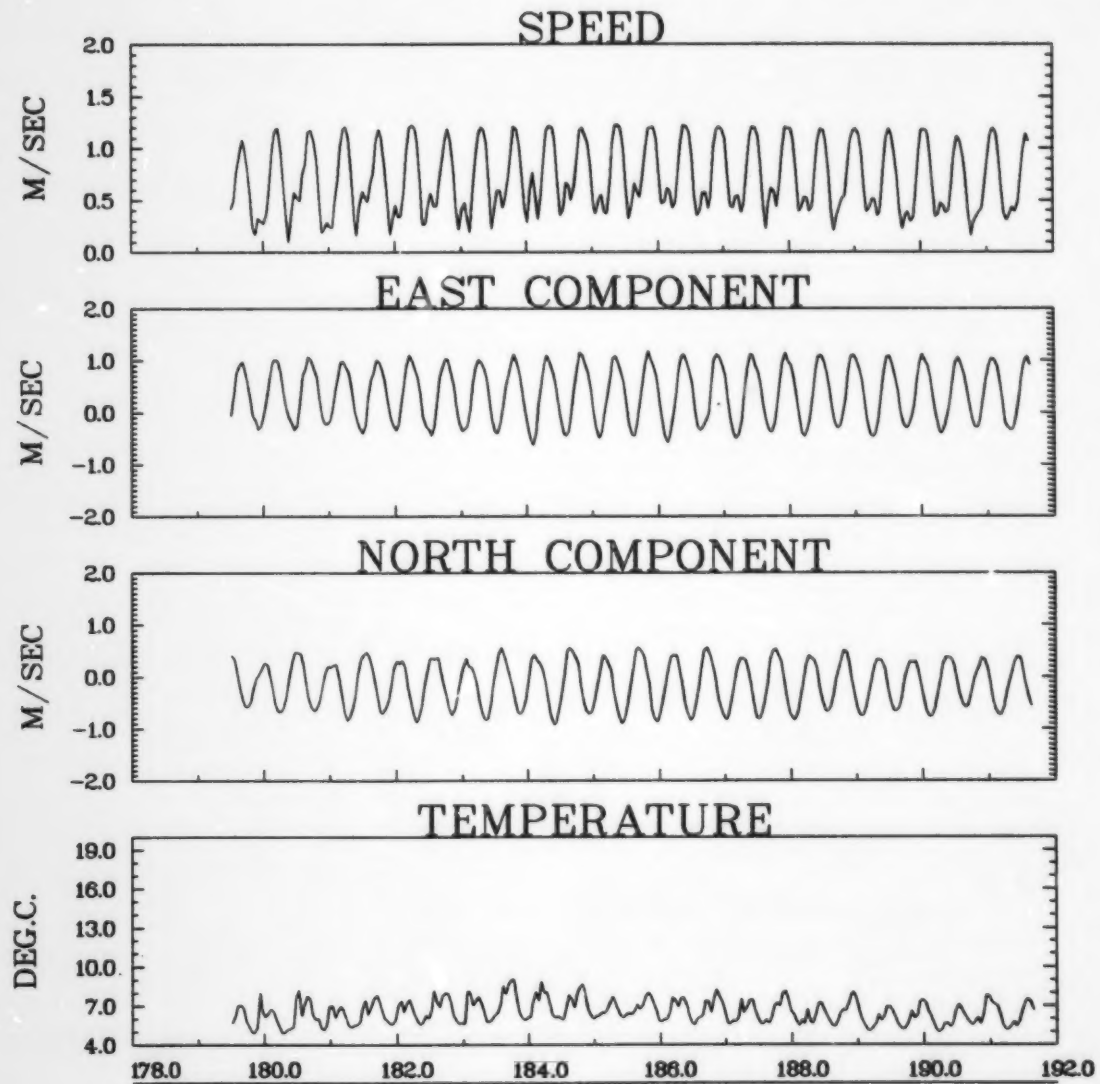
Site 5 at 39 m, 1988

(Mooring 896)

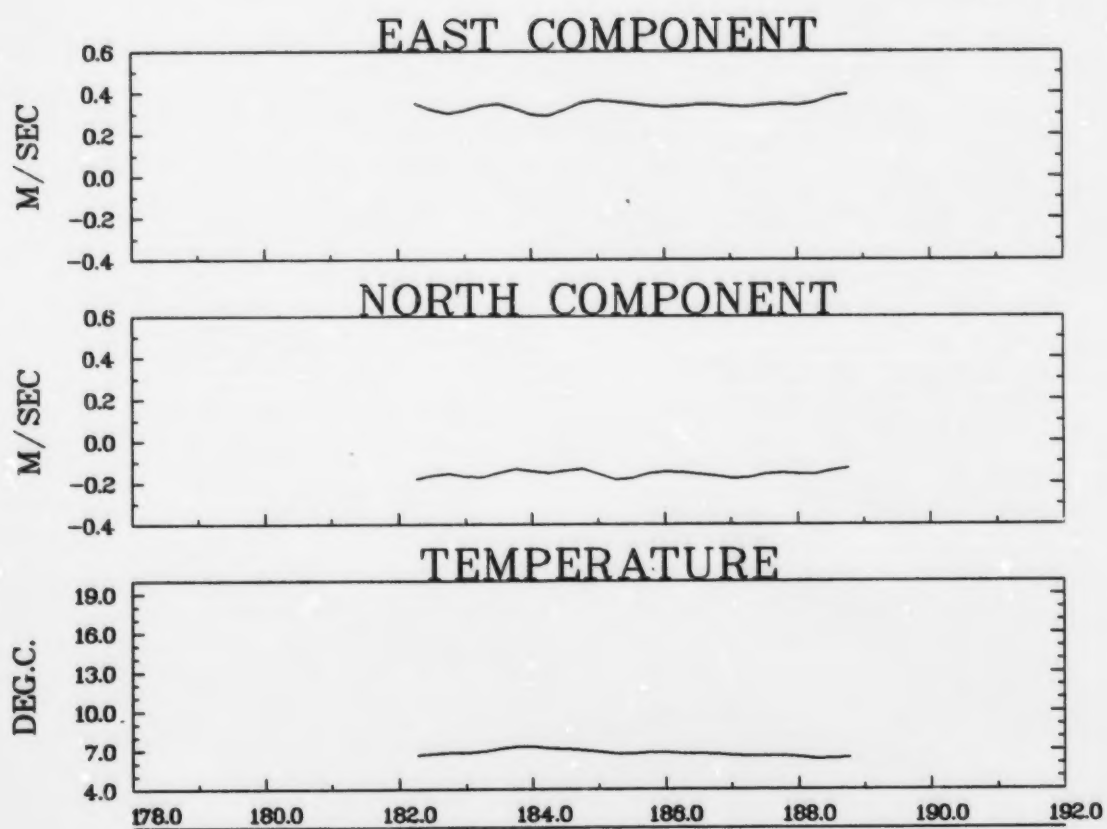
RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})					
N	292	84	208		
$\bar{X}$	0.349	0.365	0.342		
Σ_1	0.531	0.487	0.549		
Σ_6	0.023	0.023	0.022		
North Velocity Component (m.s^{-1})					
N	292	84	208		
$\bar{X}$	-0.152	-0.156	-0.151		
Σ_1	0.432	0.407	0.442		
Σ_6	0.015	0.013	0.015		
Temperature ($^{\circ}\text{C}$)					
N	292	84	208		
$\bar{X}$	6.54	6.40	6.60		
Σ_1	0.89	0.87	0.89		
Σ_6	0.26	0.10	0.27		

N: number of samples in statistics

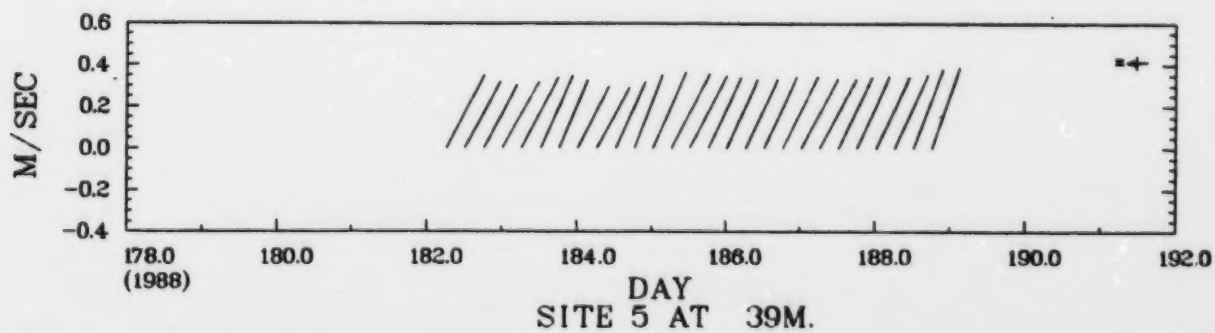
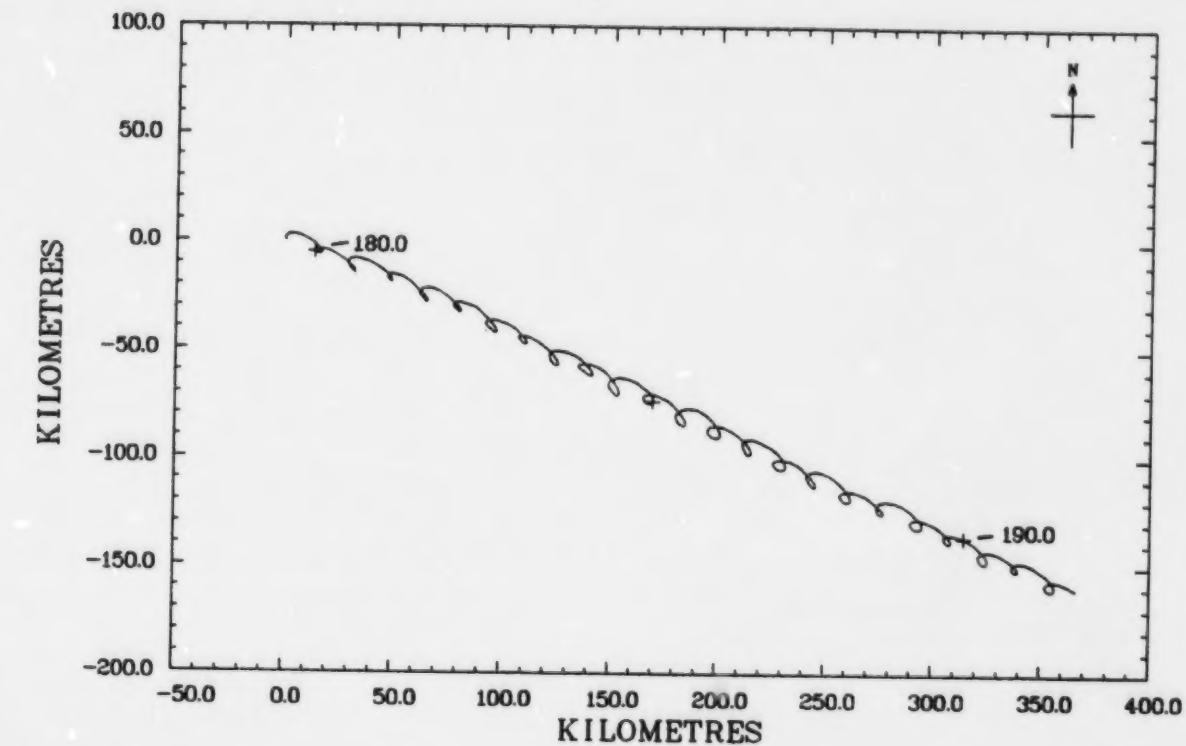
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 5 AT 39 M.



SITE 5 AT 39 M.



STATISTICS

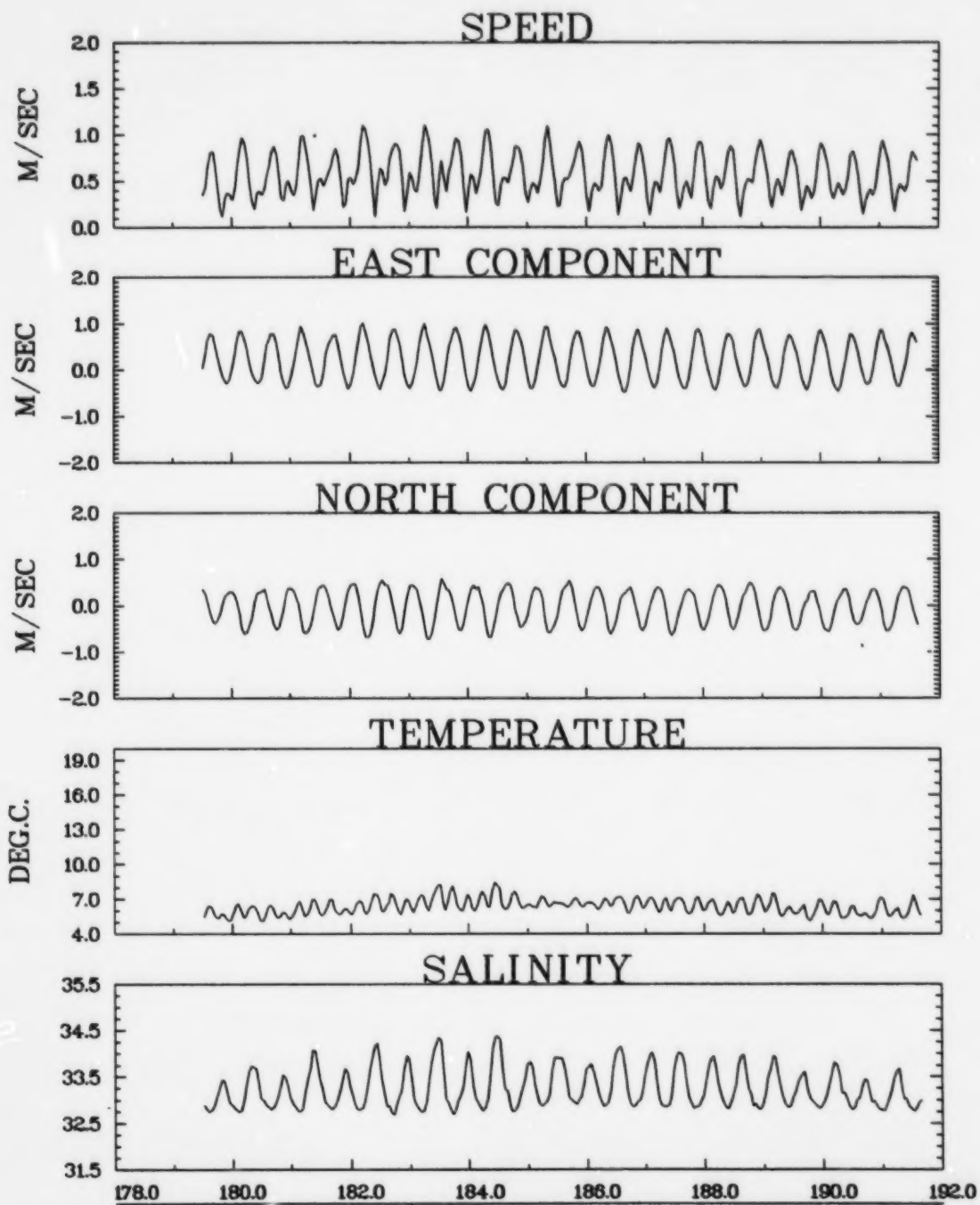
Site 5 at 71 m, 1988

(Mooring 896)

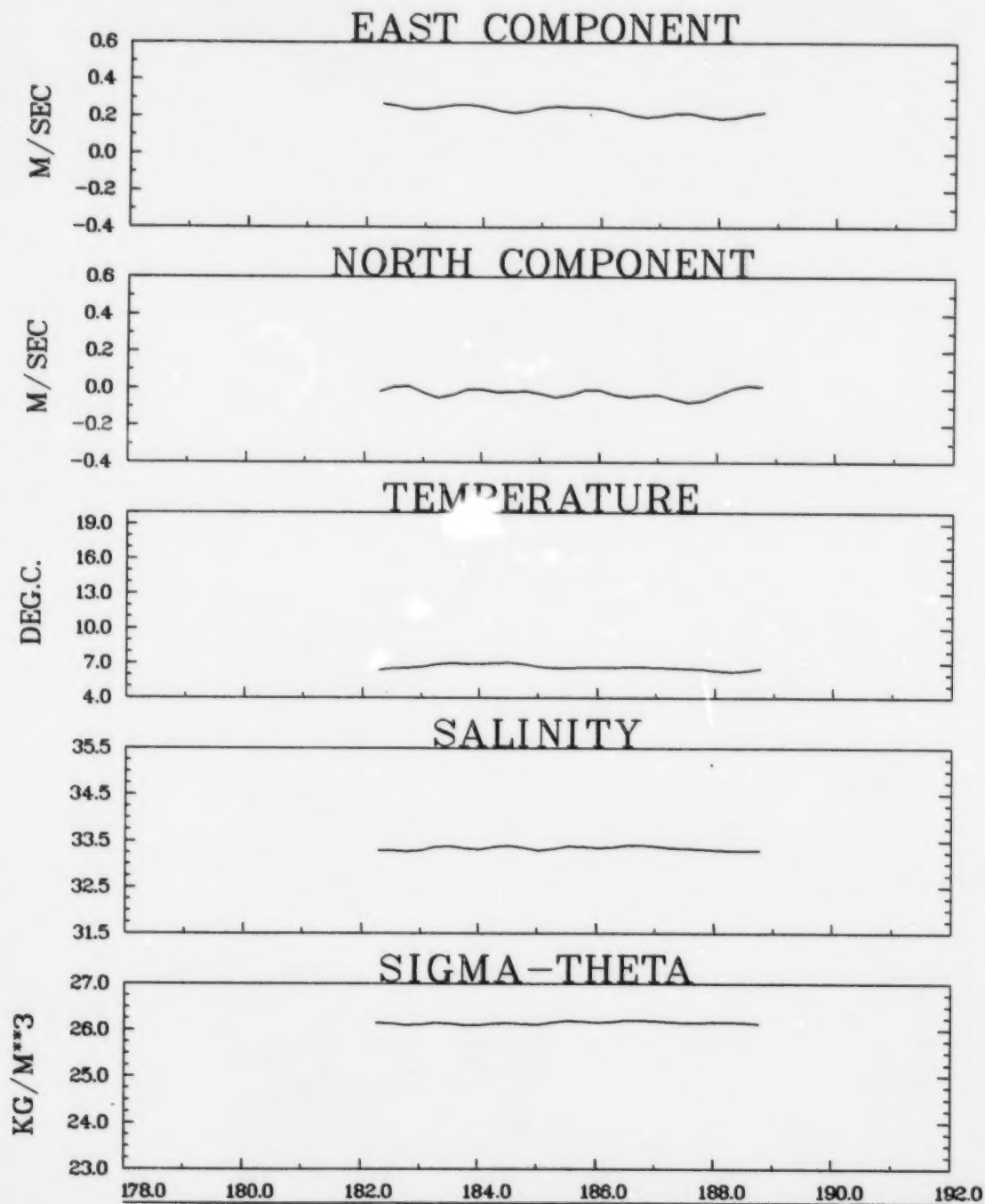
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	0.231	0.252	0.223			
Σ_1	0.441	0.427	0.447			
Σ_6	0.023	0.015	0.023			
North Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	-0.035	-0.042	-0.031			
Σ_1	0.357	0.363	0.355			
Σ_6	0.024	0.016	0.023			
Temperature ($^{\circ}\text{C}$)						
N	292	84	208			
$\bar{X}$	6.38	6.11	6.49			
Σ_1	0.65	0.58	0.65			
Σ_6	0.21	0.08	0.21			
Salinity (PSS78)						
N	292	84	208			
$\bar{X}$	33.25	33.19	33.28			
Σ_1	0.42	0.40	0.43			
Σ_6	0.04	0.02	0.04			
Sigma-theta (kg.m^{-3})						
N	292	84	208			
$\bar{X}$	26.12	26.11	26.13			
Σ_1	0.32	0.31	0.32			
Σ_6	0.03	0.02	0.03			

N: number of samples in statistics

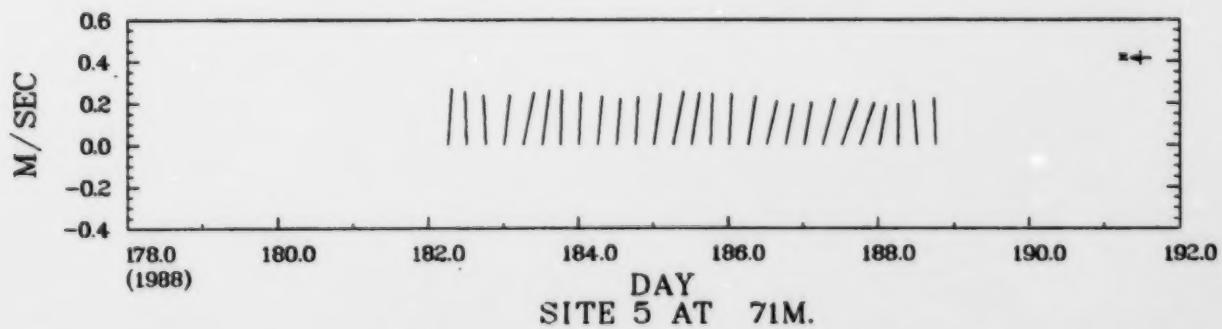
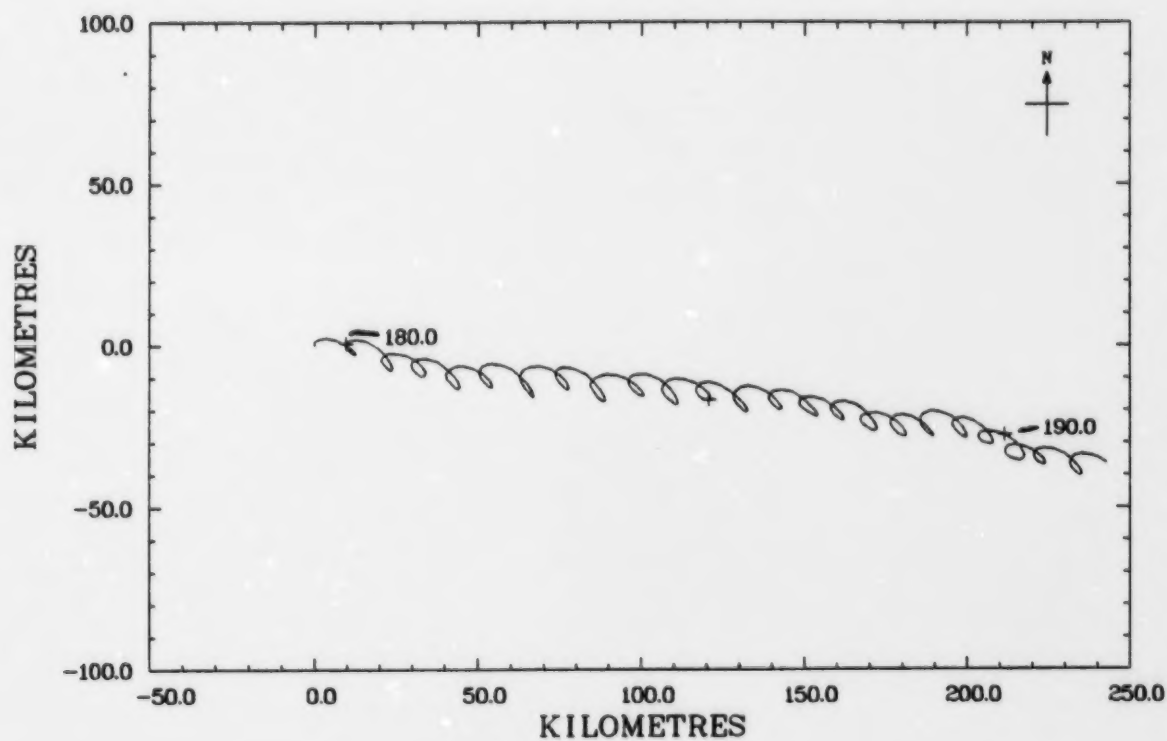
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 5 AT 71 M.



SITE 5 AT 71 M.



STATISTICS

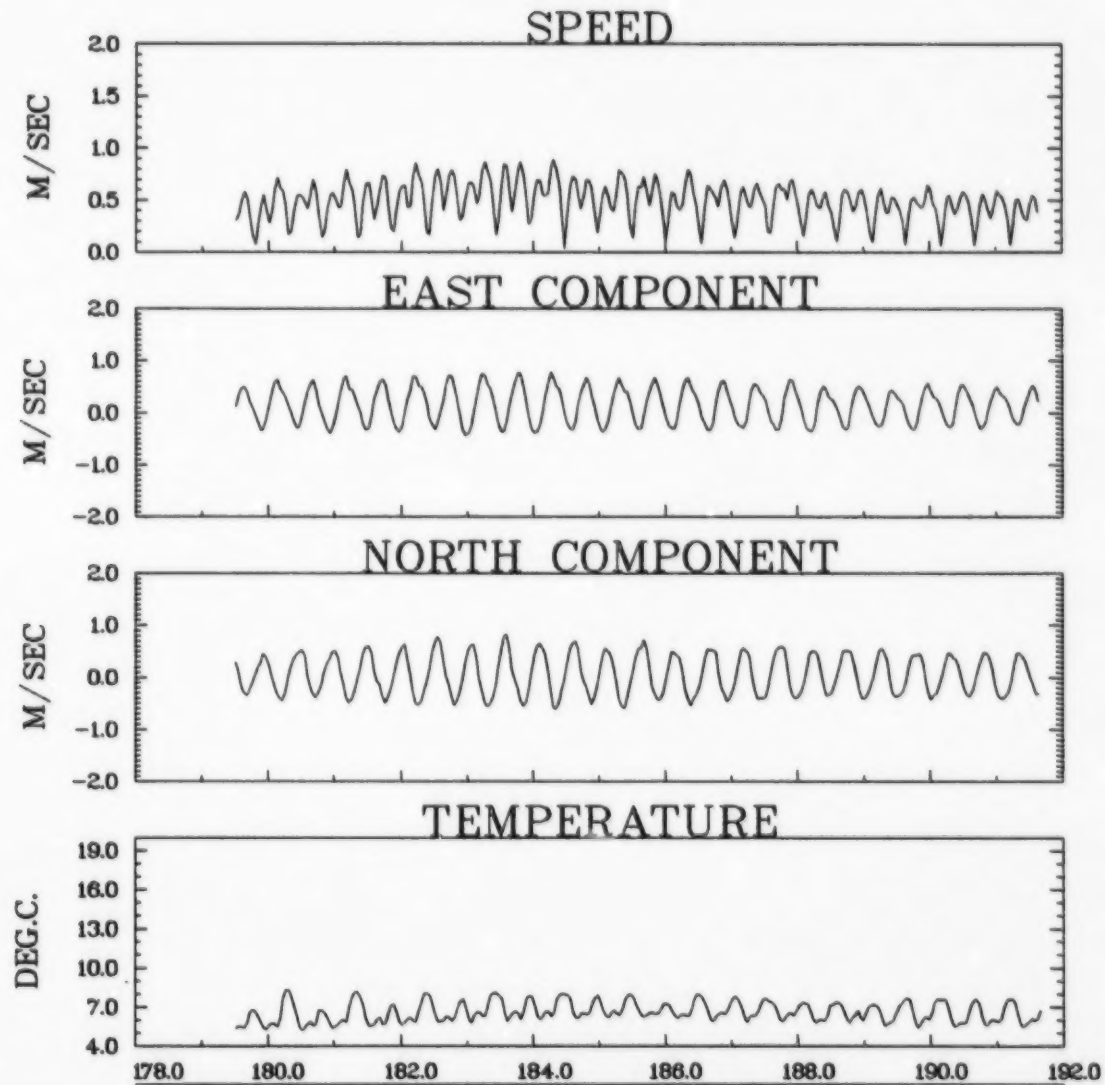
Site 5 at 102 m, 1988

(Mooring 896)

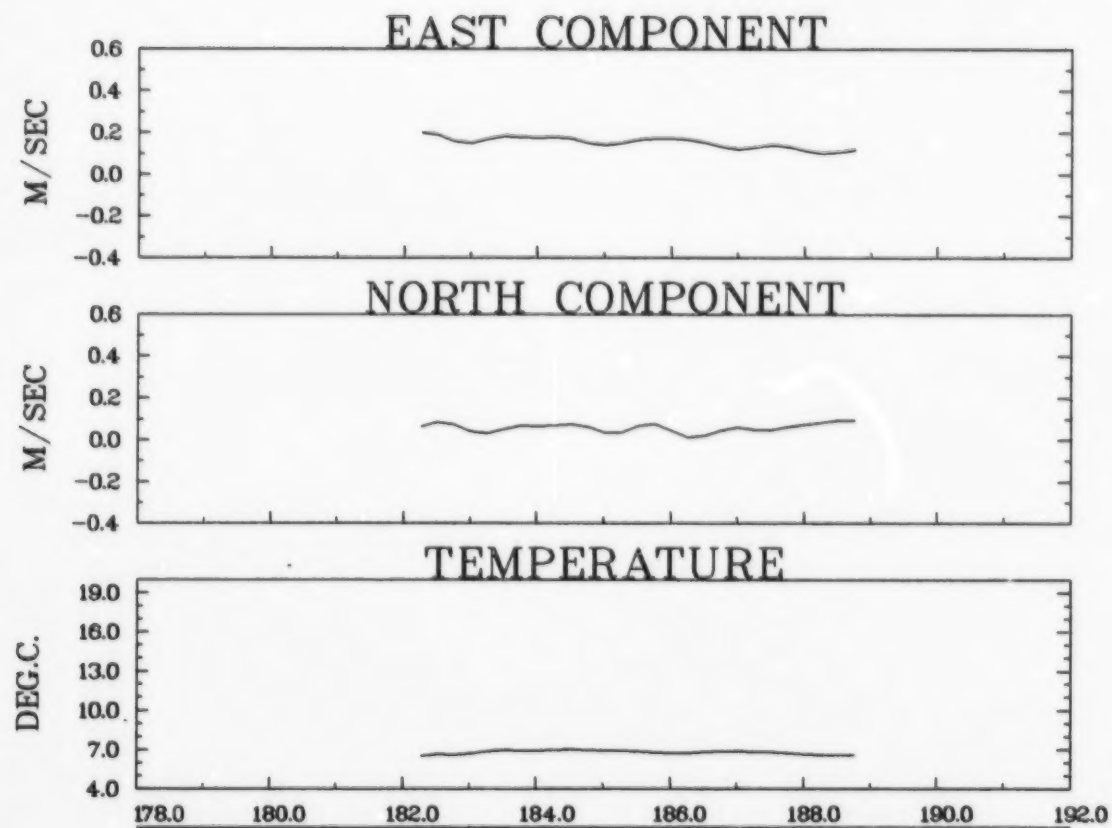
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	0.148	0.161	0.142			
Σ_1	0.332	0.341	0.328			
Σ_6	0.026	0.021	0.025			
North Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	0.050	0.037	0.056			
Σ_1	0.374	0.361	0.380			
Σ_6	0.021	0.011	0.021			
Temperature ($^{\circ}\text{C}$)						
N	292	84	208			
$\bar{X}$	6.61	6.35	6.71			
Σ_1	0.75	0.84	0.68			
Σ_6	0.14	0.05	0.13			

N: number of samples in statistics

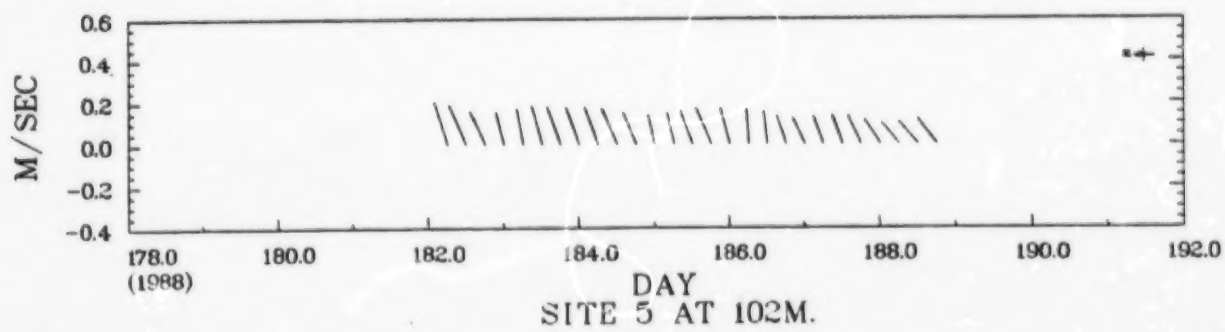
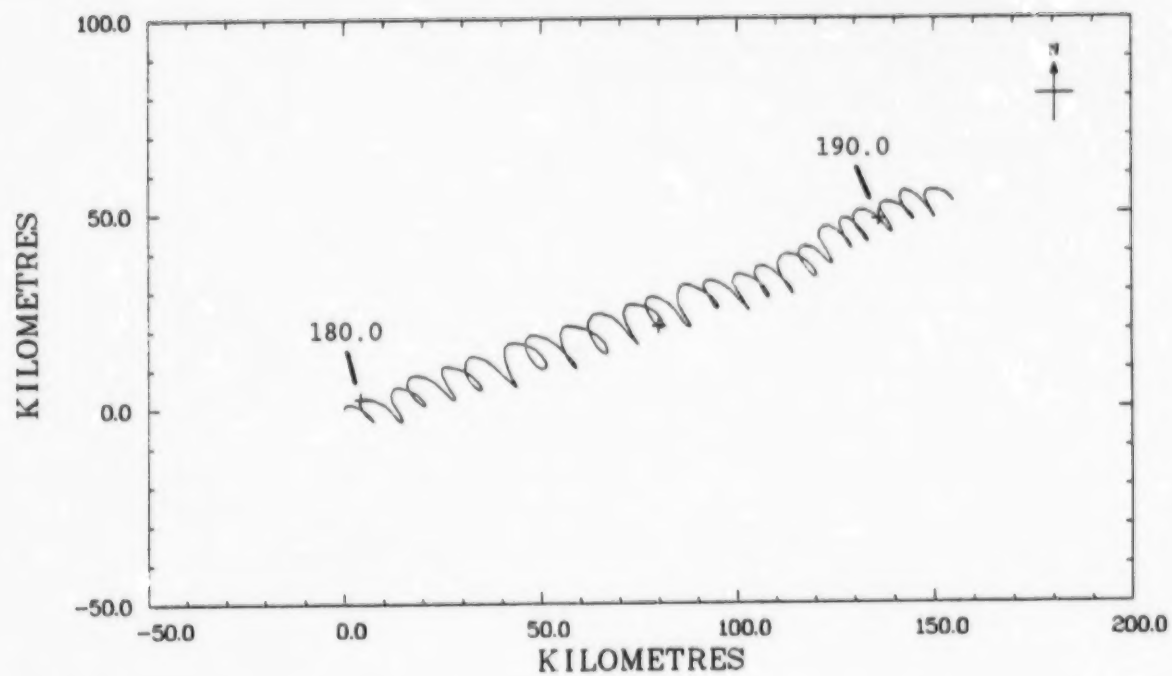
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 5 AT 102 M.



SITE 5 AT 102 M.



STATISTICS

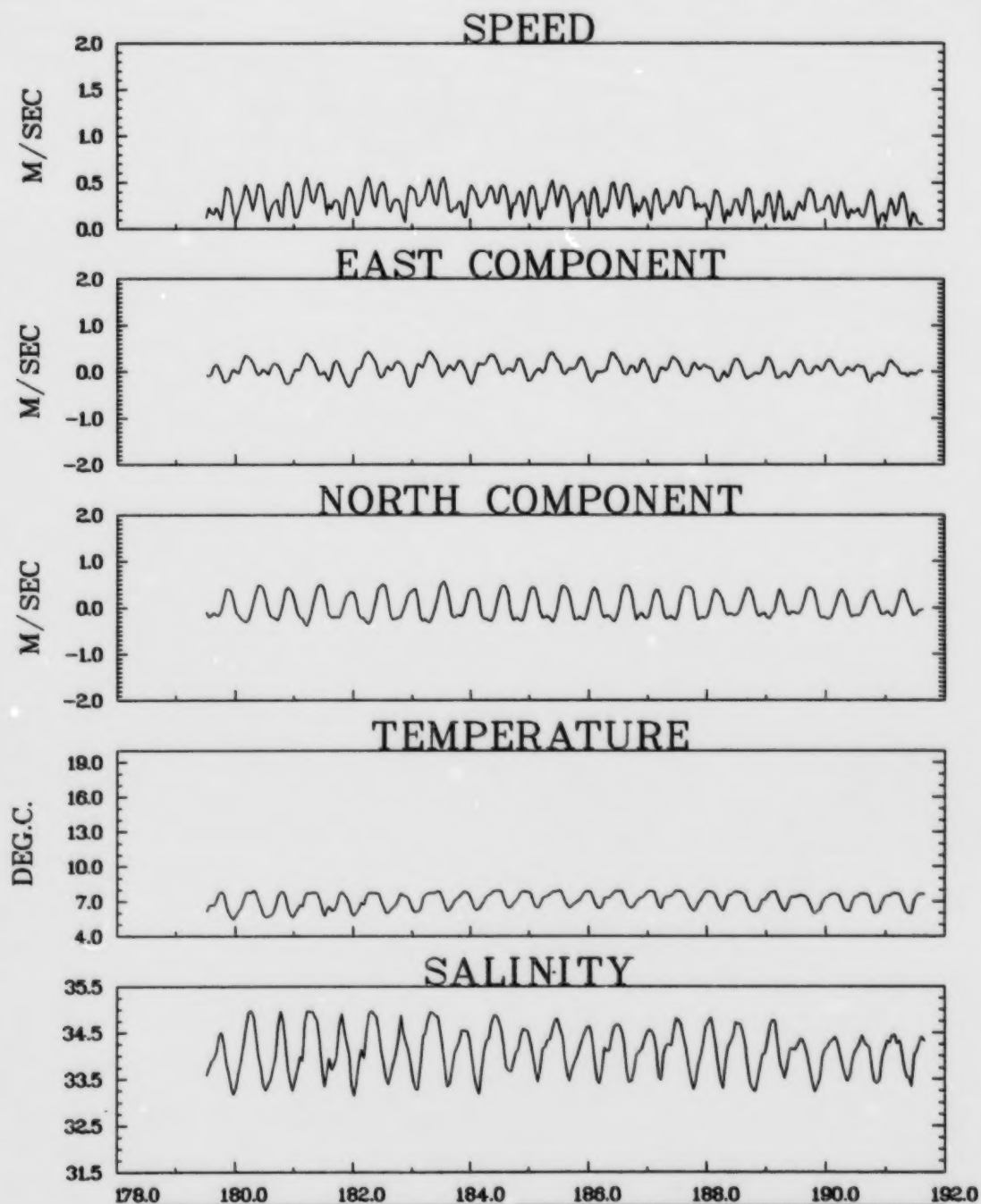
Site 5 at 138 m, 1988

(Mooring 896)

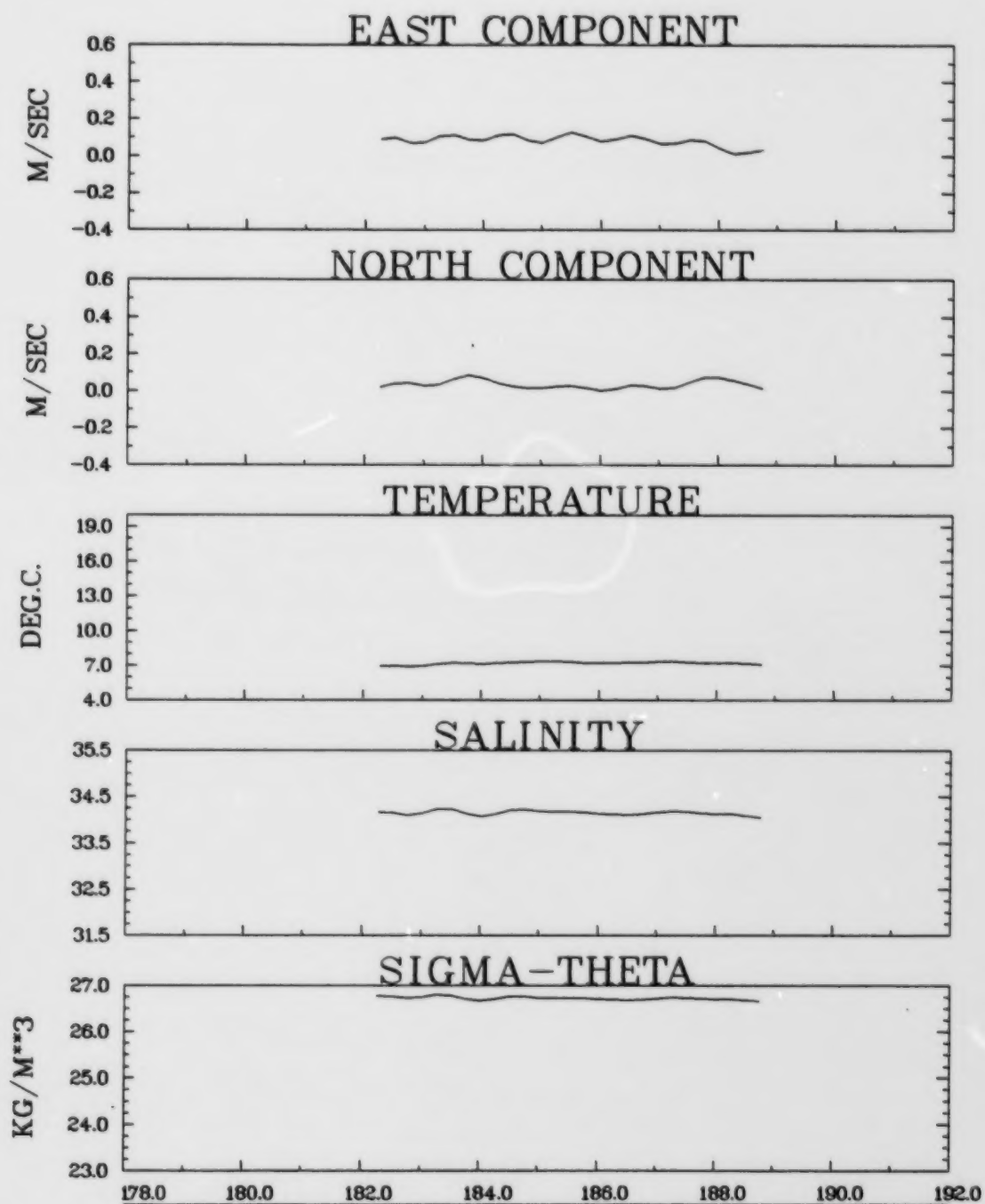
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	0.063	0.045	0.070			
Σ_1	0.160	0.182	0.150			
Σ_6	0.033	0.014	0.030			
North Velocity Component (m.s^{-1})						
N	292	84	208			
$\bar{X}$	0.031	0.024	0.034			
Σ_1	0.259	0.271	0.255			
Σ_6	0.029	0.012	0.023			
Temperature ($^{\circ}\text{C}$)						
N	292	84	208			
$\bar{X}$	7.08	6.85	7.17			
Σ_1	0.65	0.74	0.59			
Σ_6	0.13	0.02	0.09			
Salinity (PSS78)						
N	292	84	208			
$\bar{X}$	34.10	34.09	34.10			
Σ_1	0.48	0.55	0.45			
Σ_6	0.05	0.04	0.05			
Sigma-theta (kg.m^{-3})						
N	292	84	208			
$\bar{X}$	26.70	26.72	26.69			
Σ_1	0.29	0.34	0.28			
Σ_6	0.03	0.03	0.03			

N: number of samples in statistics

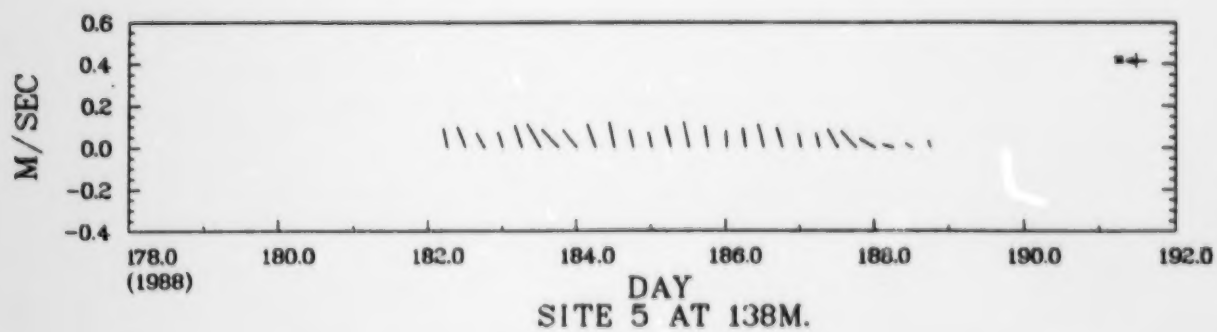
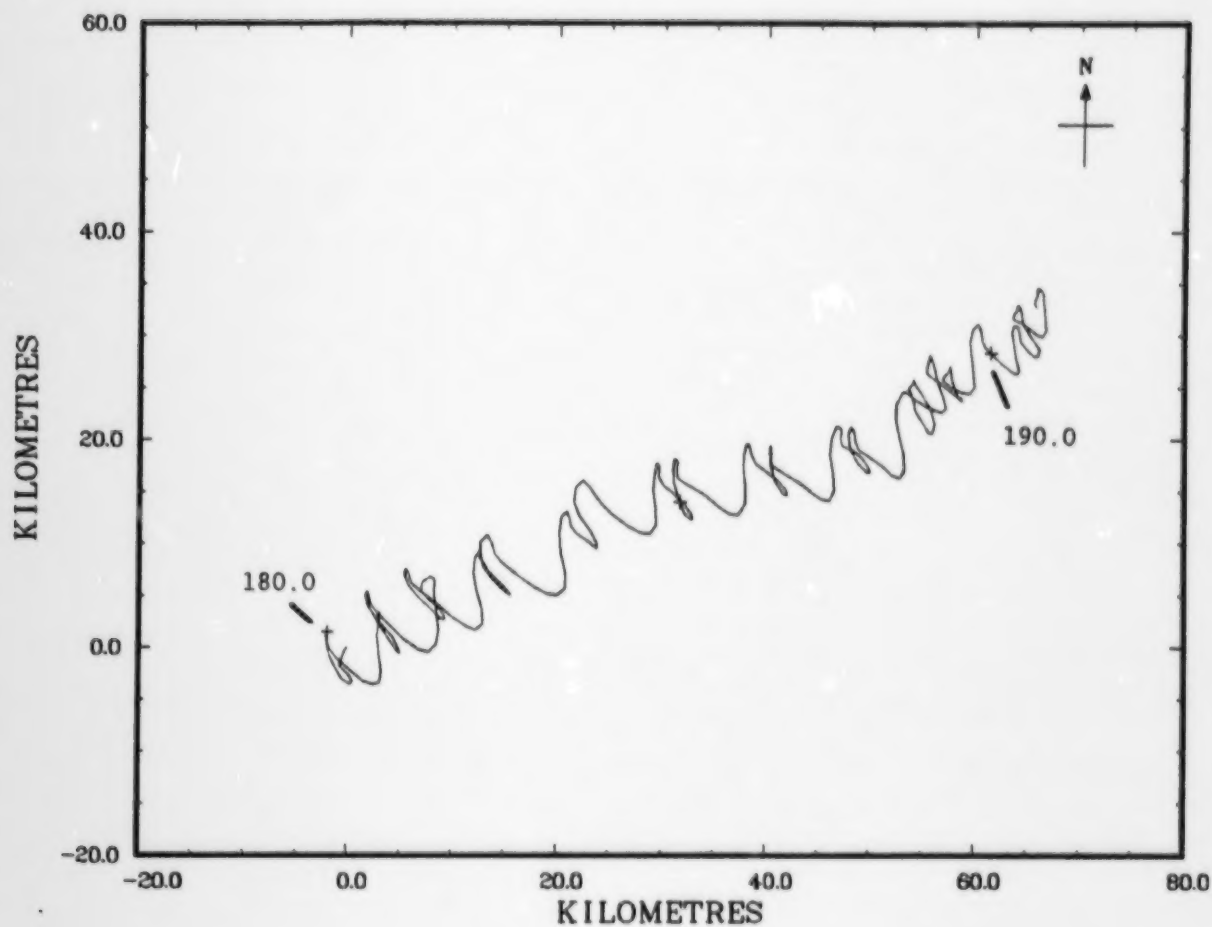
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 5 AT 138 M.



SITE 5 AT 138 M.



STATISTICS

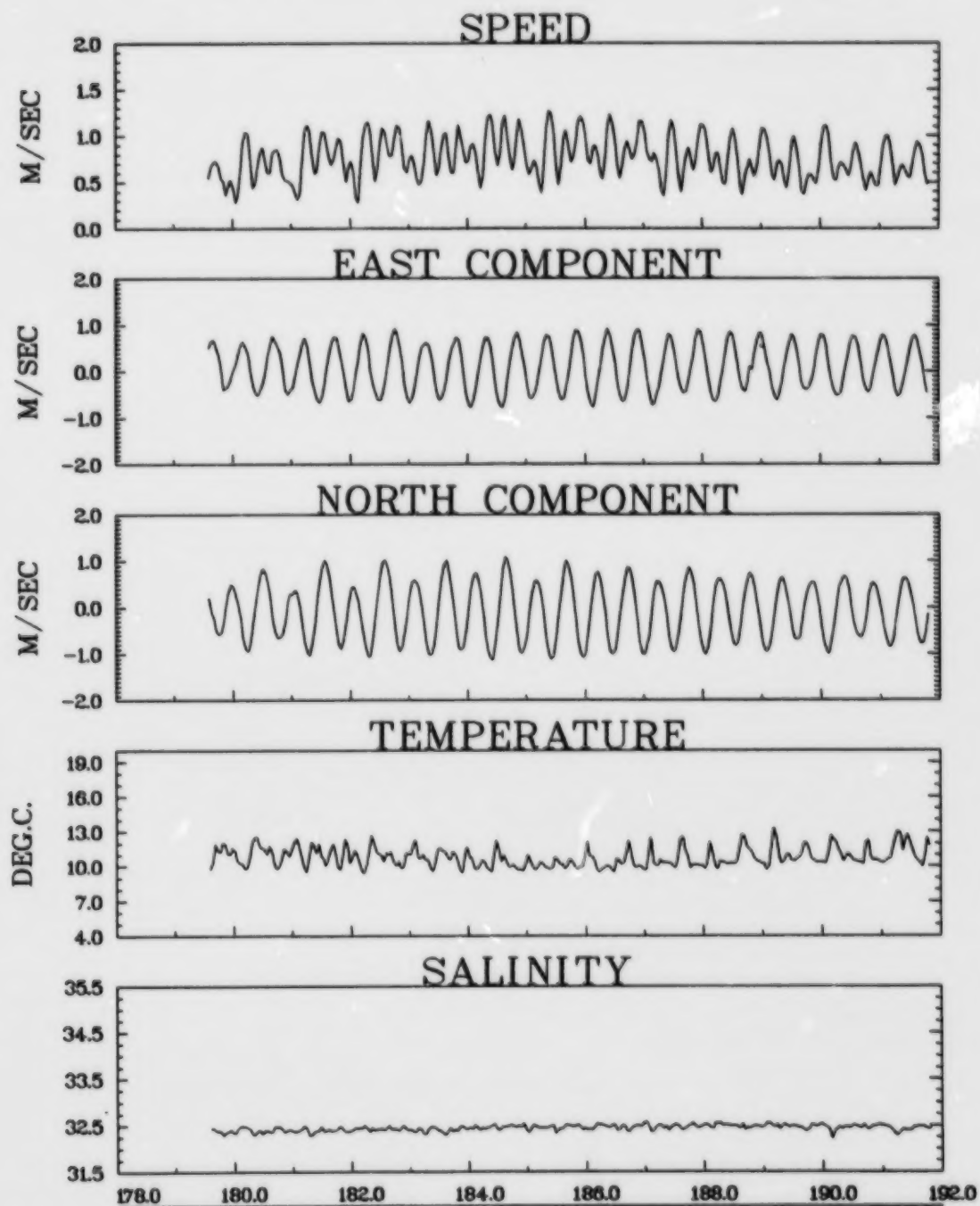
Site 6 at 10 m, 1988

(Mooring 897)

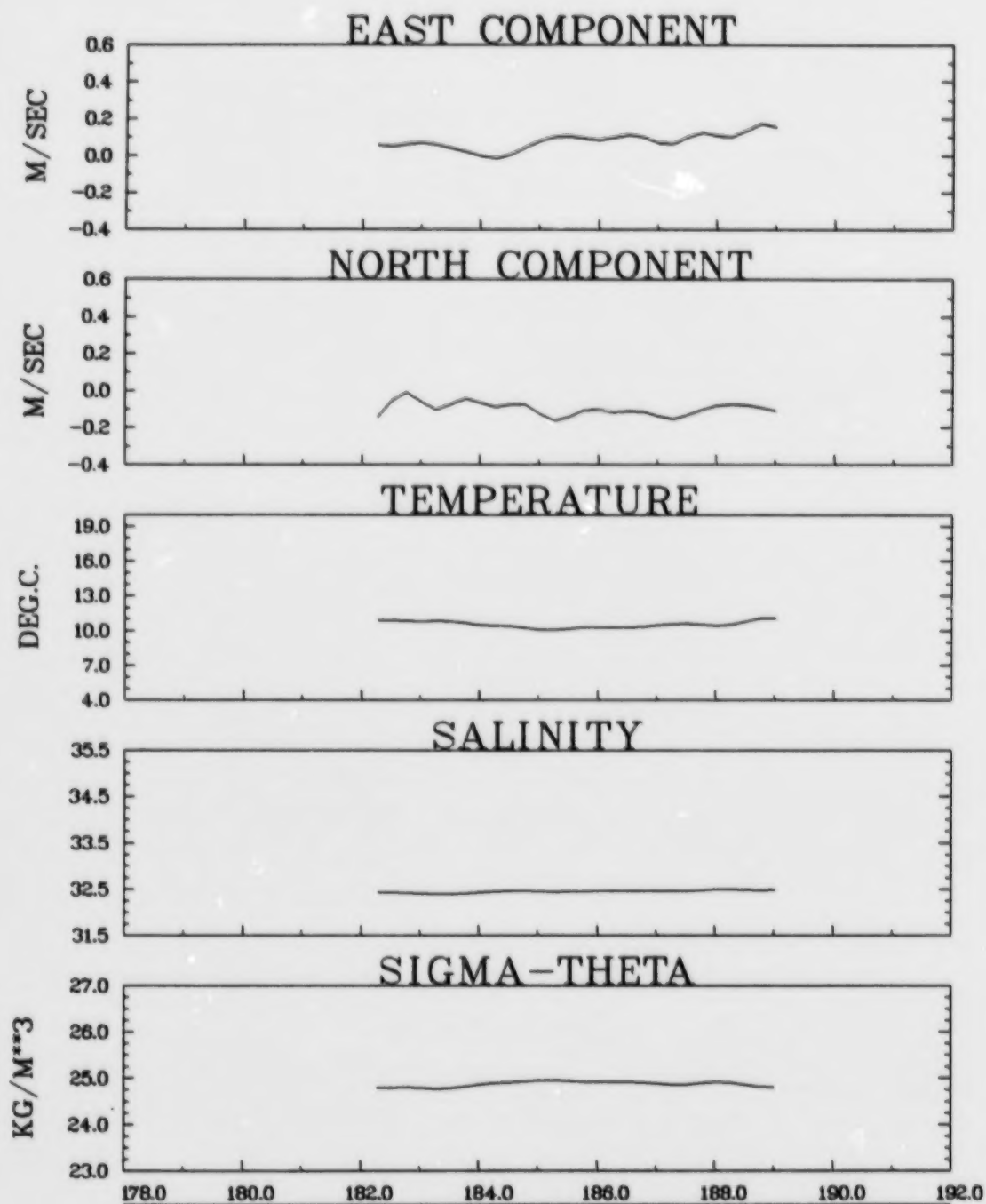
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	0.094	0.097	0.093			
Σ_1	0.495	0.469	0.506			
Σ_6	0.045	0.006	0.047			
North Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	-0.098	-0.101	-0.097			
Σ_1	0.607	0.588	0.616			
Σ_6	0.035	0.069	0.030			
Temperature ($^{\circ}\text{C}$)						
N	294	82	212			
$\bar{X}$	10.77	11.00	10.69			
Σ_1	0.83	0.81	0.83			
Σ_6	0.29	0.03	0.28			
Salinity (PSS78)						
N	294	82	212			
$\bar{X}$	32.44	32.40	32.46			
Σ_1	0.06	0.05	0.06			
Σ_6	0.03	0.00	0.03			
Sigma-theta (kg.m^{-3})						
N	294	82	212			
$\bar{X}$	24.82	24.75	24.85			
Σ_1	0.18	0.17	0.17			
Σ_6	0.06	0.00	0.06			

N: number of samples in statistics

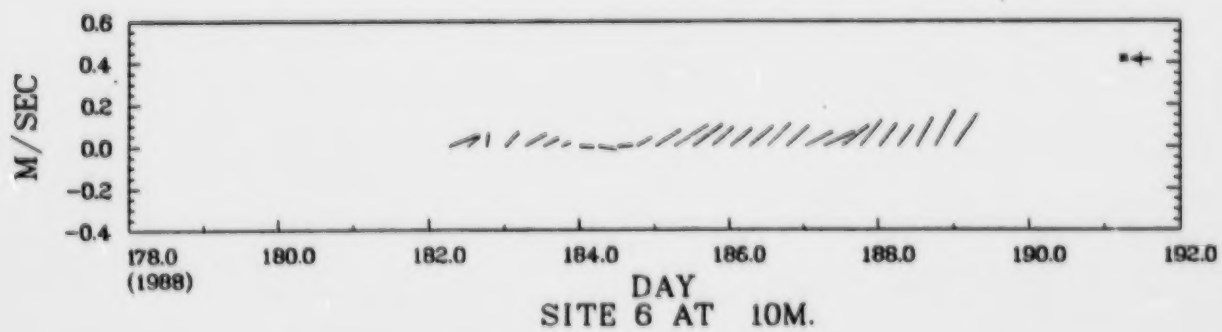
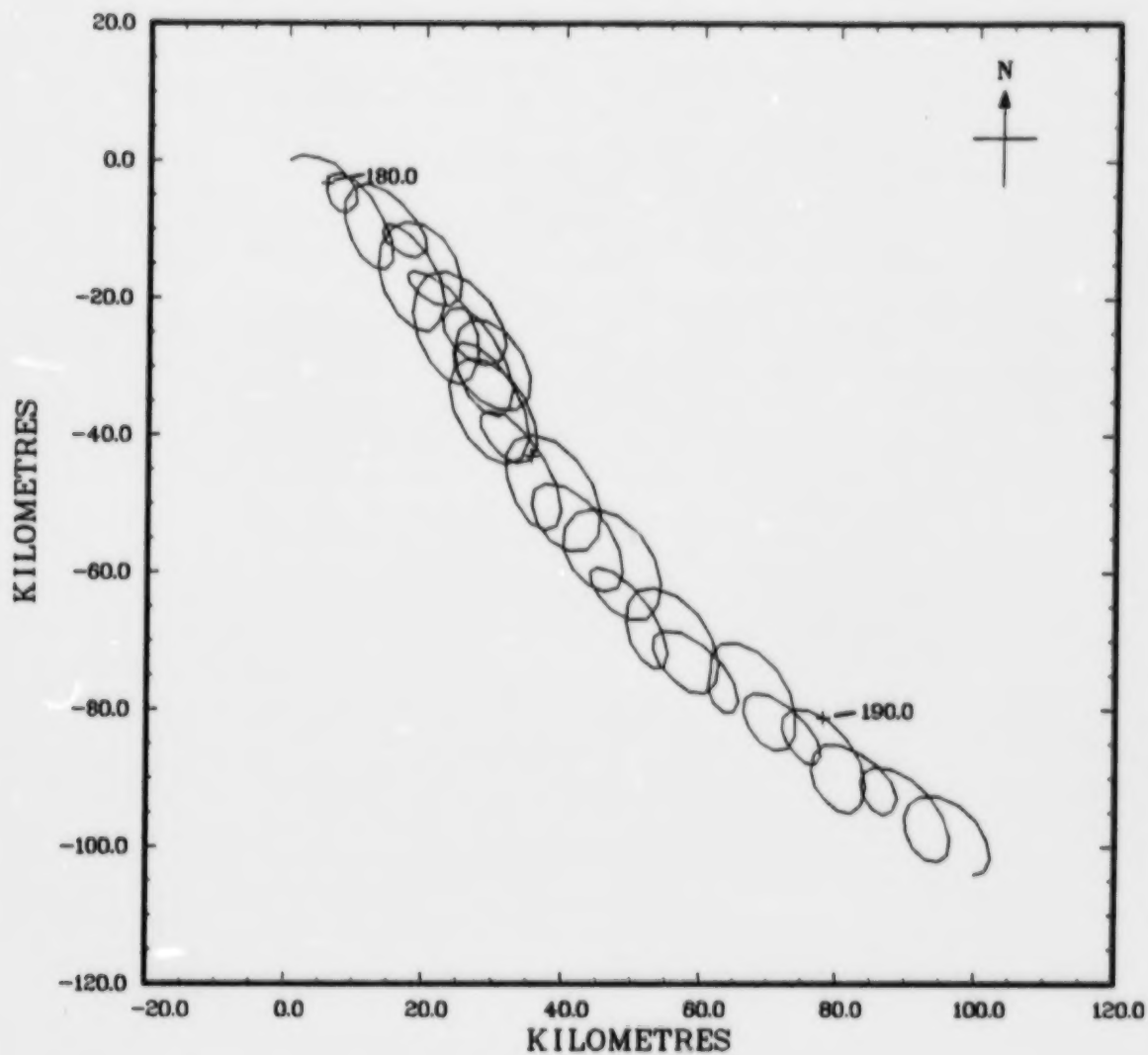
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 6 AT 10 M.



SITE 6 AT 10 M.



STATISTICS

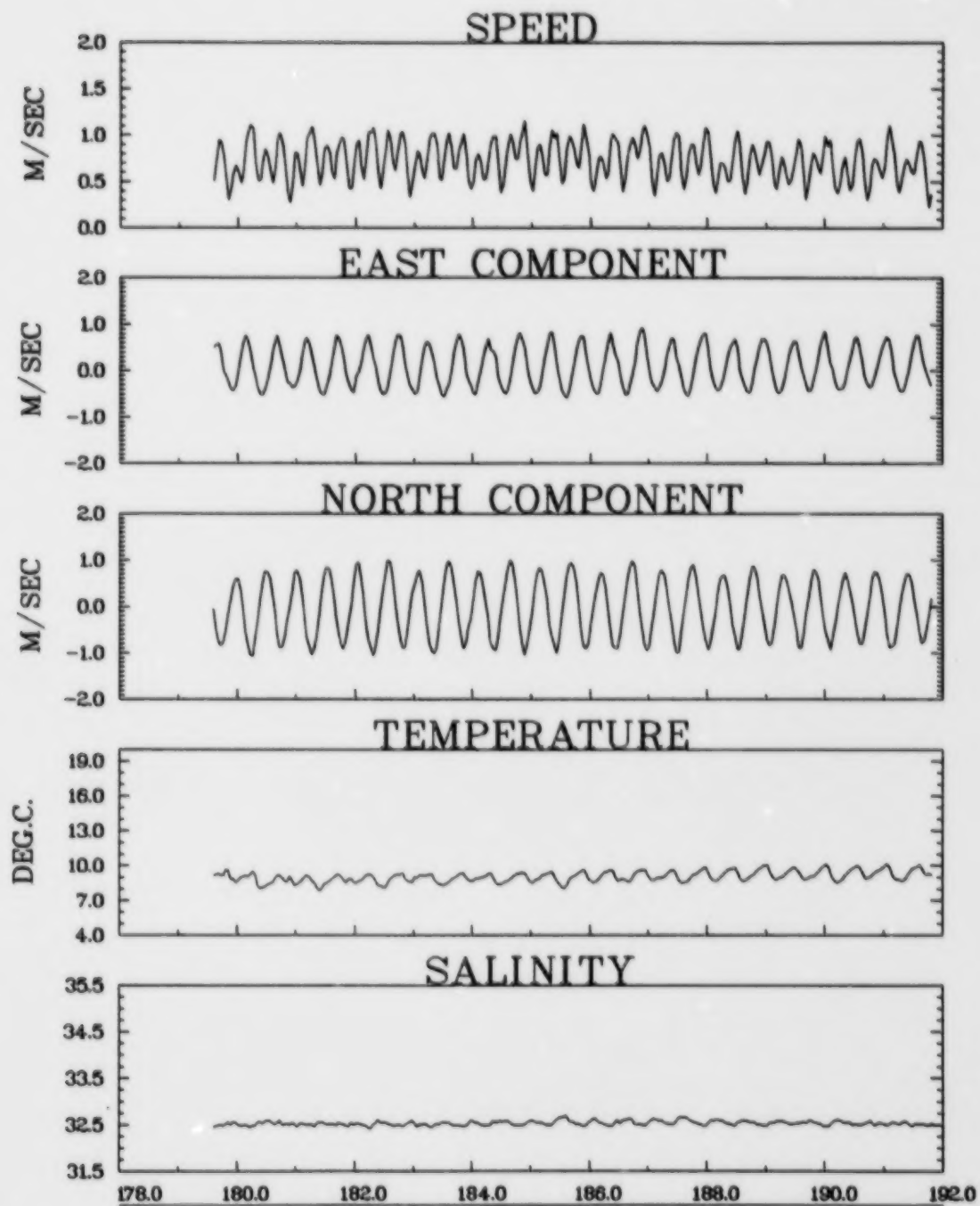
Site 6 at 41 m, 1988

(Mooring 897)

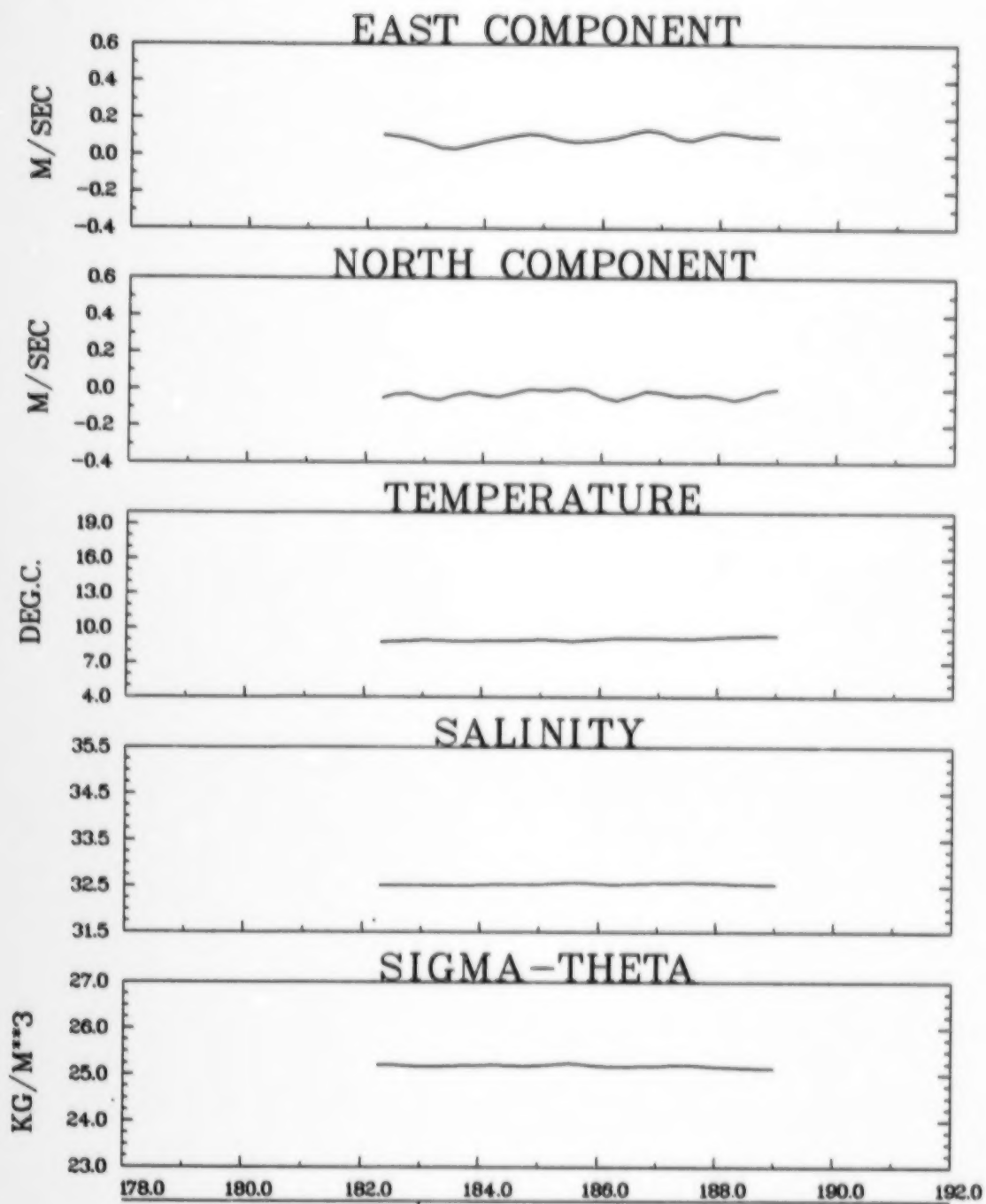
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	0.097	0.093	0.098			
Σ_1	0.428	0.421	0.432			
Σ_6	0.025	0.011	0.026			
North Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	-0.054	-0.111	-0.031			
Σ_1	0.617	0.628	0.613			
Σ_6	0.019	0.014	0.020			
Temperature ($^{\circ}\text{C}$)						
N	294	82	212			
$\bar{X}$	9.04	8.80	9.14			
Σ_1	0.45	0.40	0.44			
Σ_6	0.17	0.06	0.16			
Salinity (PSS78)						
N	294	82	212			
$\bar{X}$	32.53	32.52	32.54			
Σ_1	0.05	0.04	0.05			
Σ_6	0.02	0.00	0.02			
Sigma-theta (kg.m^{-3})						
N	294	82	212			
$\bar{X}$	25.18	25.21	25.17			
Σ_1	0.09	0.08	0.10			
Σ_6	0.02	0.01	0.02			

N: number of samples in statistics

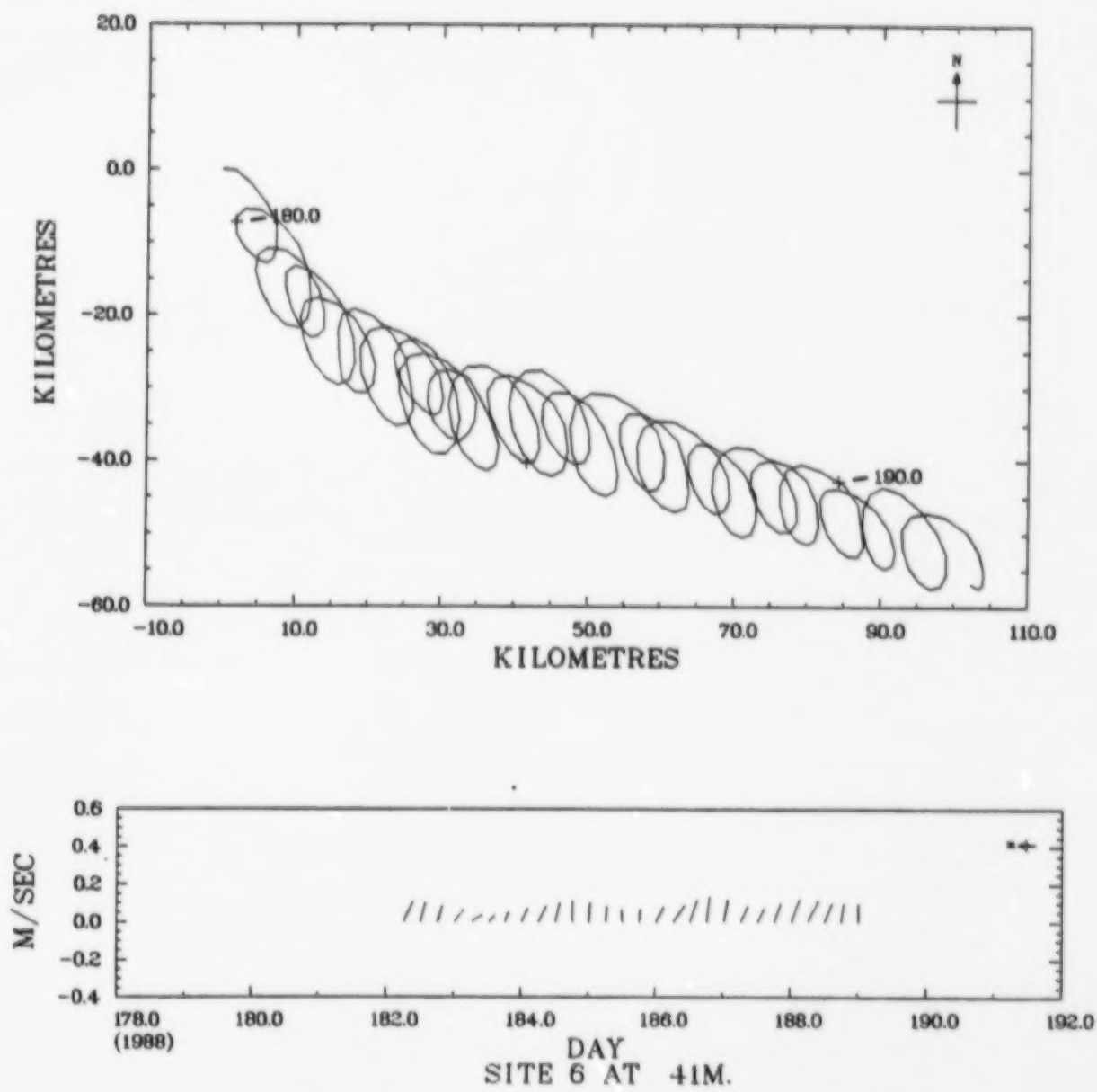
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 6 AT 41 M.



SITE 6 AT 41 M.



STATISTICS

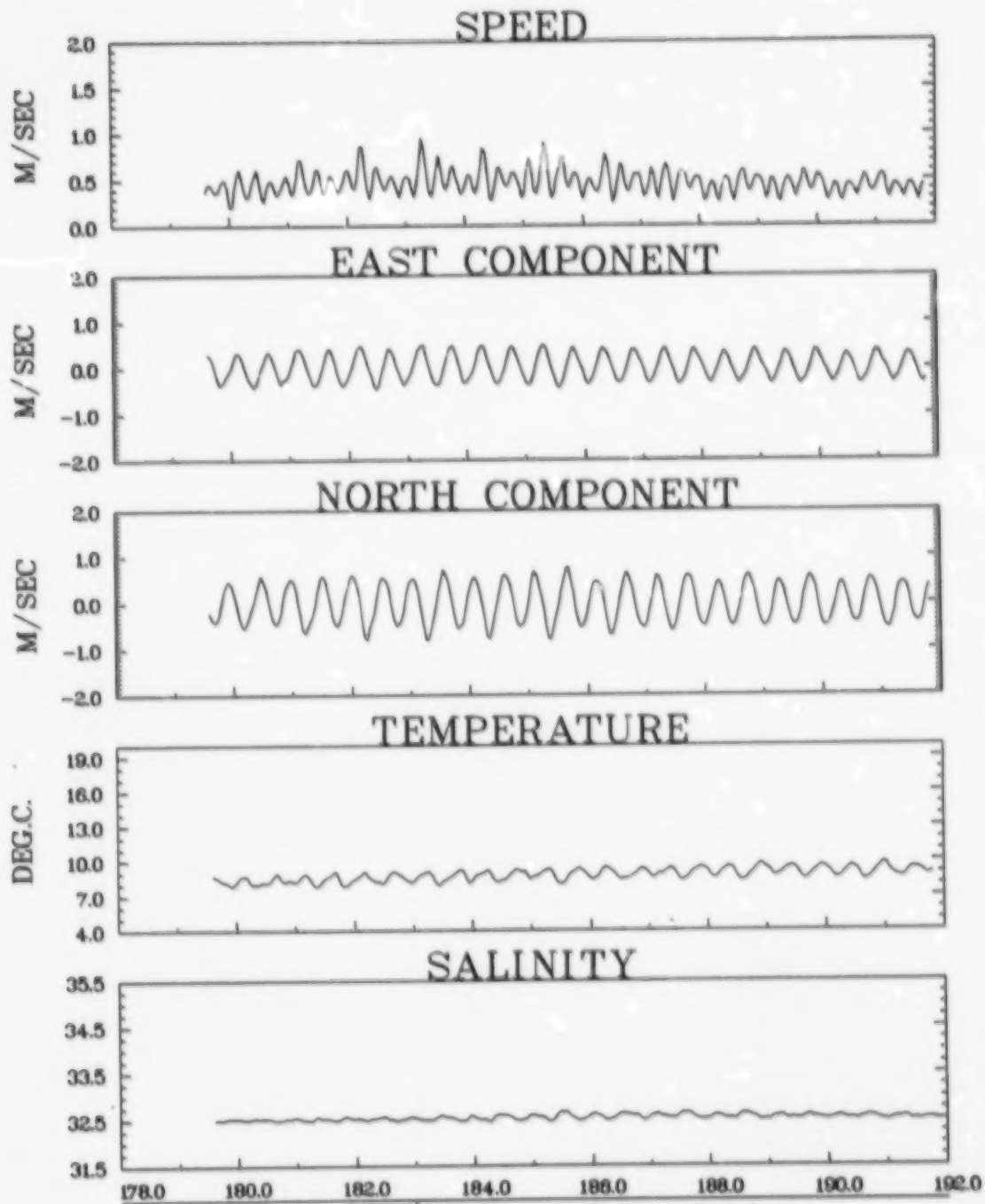
Site 6 at 73 m, 1988

(Mooring 897)

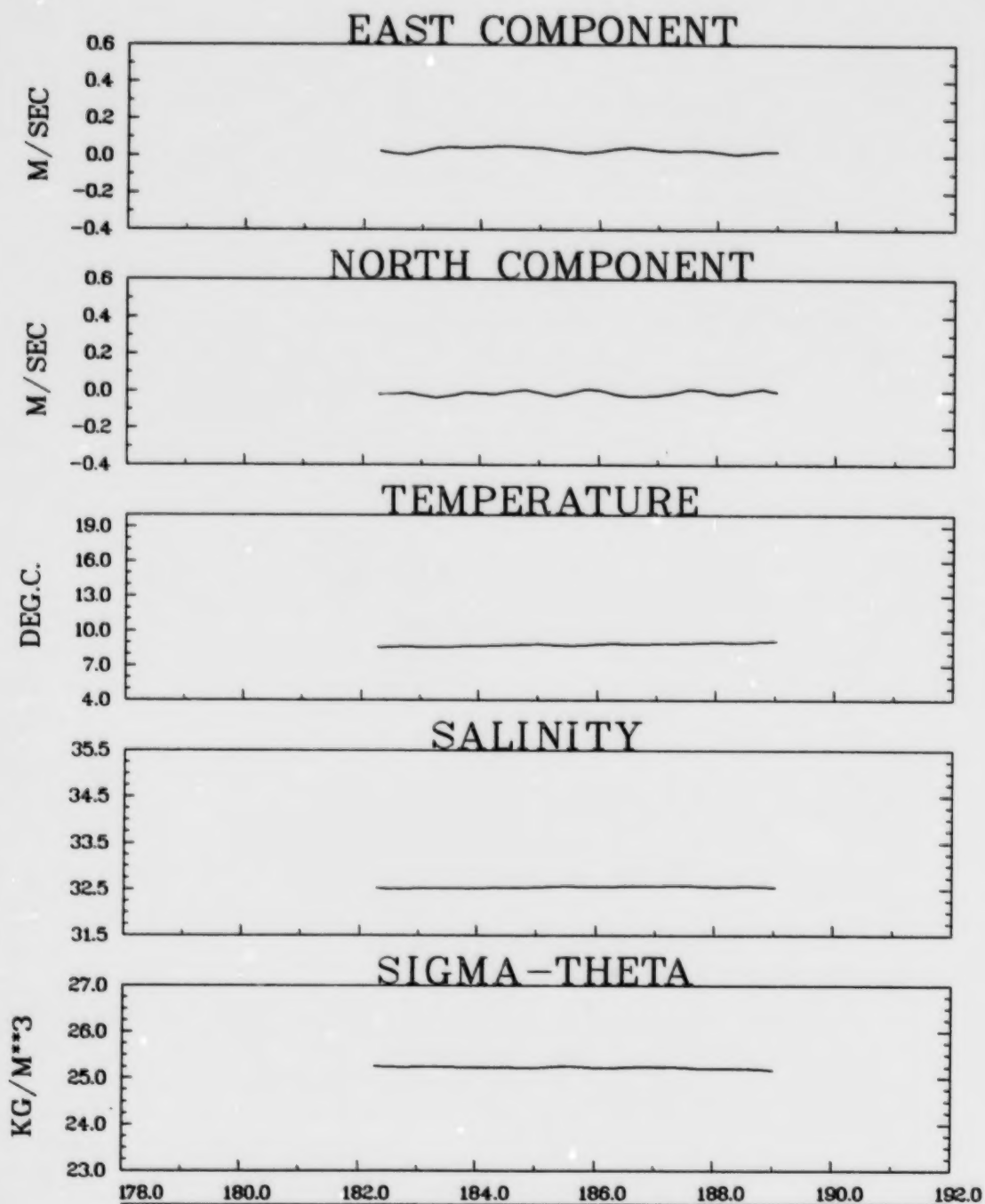
	RECORD	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
East Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	0.016	-0.007	0.024			
Σ_1	0.264	0.272	0.260			
Σ_6	0.014	0.009	0.013			
North Velocity Component (m.s^{-1})						
N	294	82	212			
$\bar{X}$	-0.016	-0.027	-0.012			
Σ_1	0.407	0.393	0.413			
Σ_6	0.013	0.004	0.014			
Temperature ($^{\circ}\text{C}$)						
N	294	82	212			
$\bar{X}$	8.77	8.41	8.91			
Σ_1	0.45	0.34	0.40			
Σ_6	0.17	0.05	0.16			
Salinity (PSS78)						
N	294	82	212			
$\bar{X}$	32.54	32.52	32.54			
Σ_1	0.04	0.02	0.04			
Σ_6	0.02	0.00	0.02			
Sigma-theta (kg.m^{-3})						
N	294	82	212			
$\bar{X}$	25.23	25.26	25.22			
Σ_1	0.09	0.07	0.09			
Σ_6	0.02	0.01	0.02			

N: number of samples in statistics

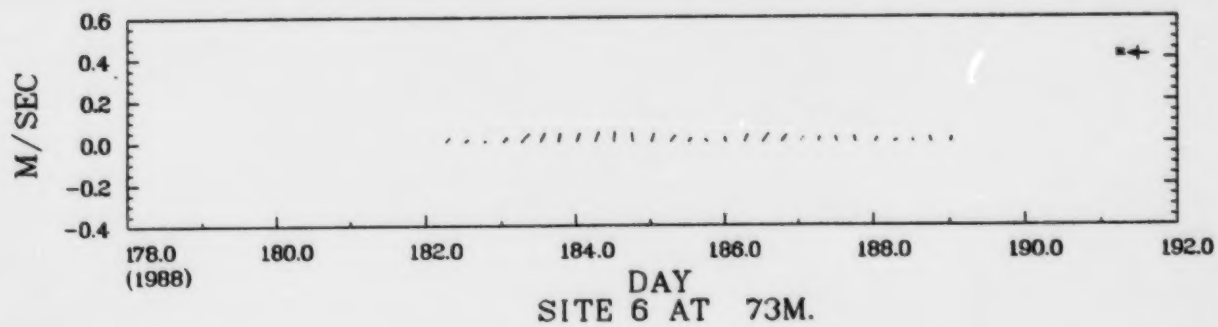
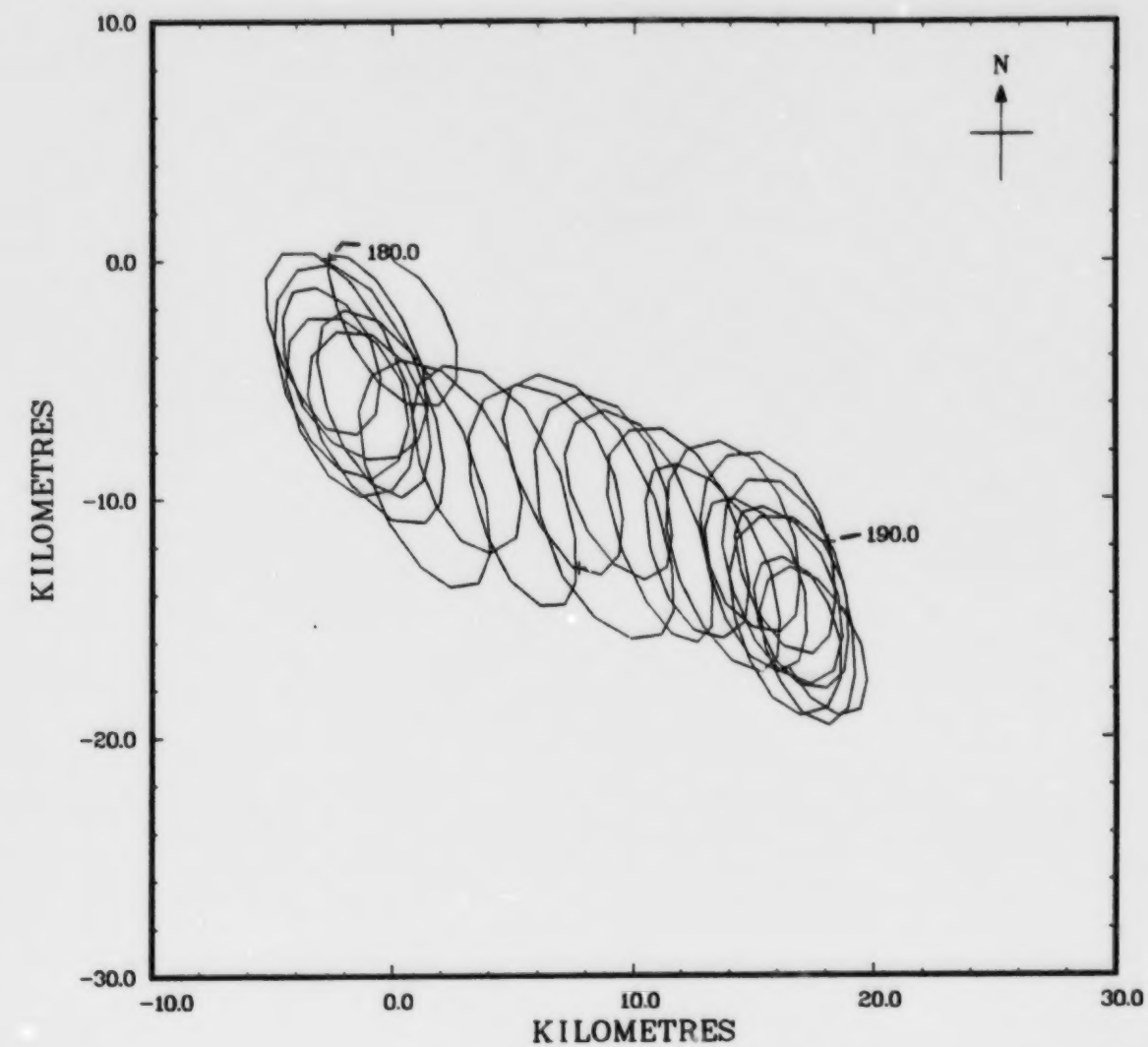
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 6 AT 73 M.



SITE 6 AT 73 M.



STATISTICS

Site 3 at 14 m, 1989

(Mooring 955)

RECORD/JULY

East Velocity Component (m.s^{-1})

N	398
$\bar{X}$	0.152
Σ_1	0.495
Σ_6	0.041

North Velocity Component (m.s^{-1})

N	398
$\bar{X}$	-0.128
Σ_1	0.715
Σ_6	0.037

Temperature ($^{\circ}\text{C}$)

N	398
$\bar{X}$	11.86
Σ_1	0.73
Σ_6	0.42

Salinity (PSS78)

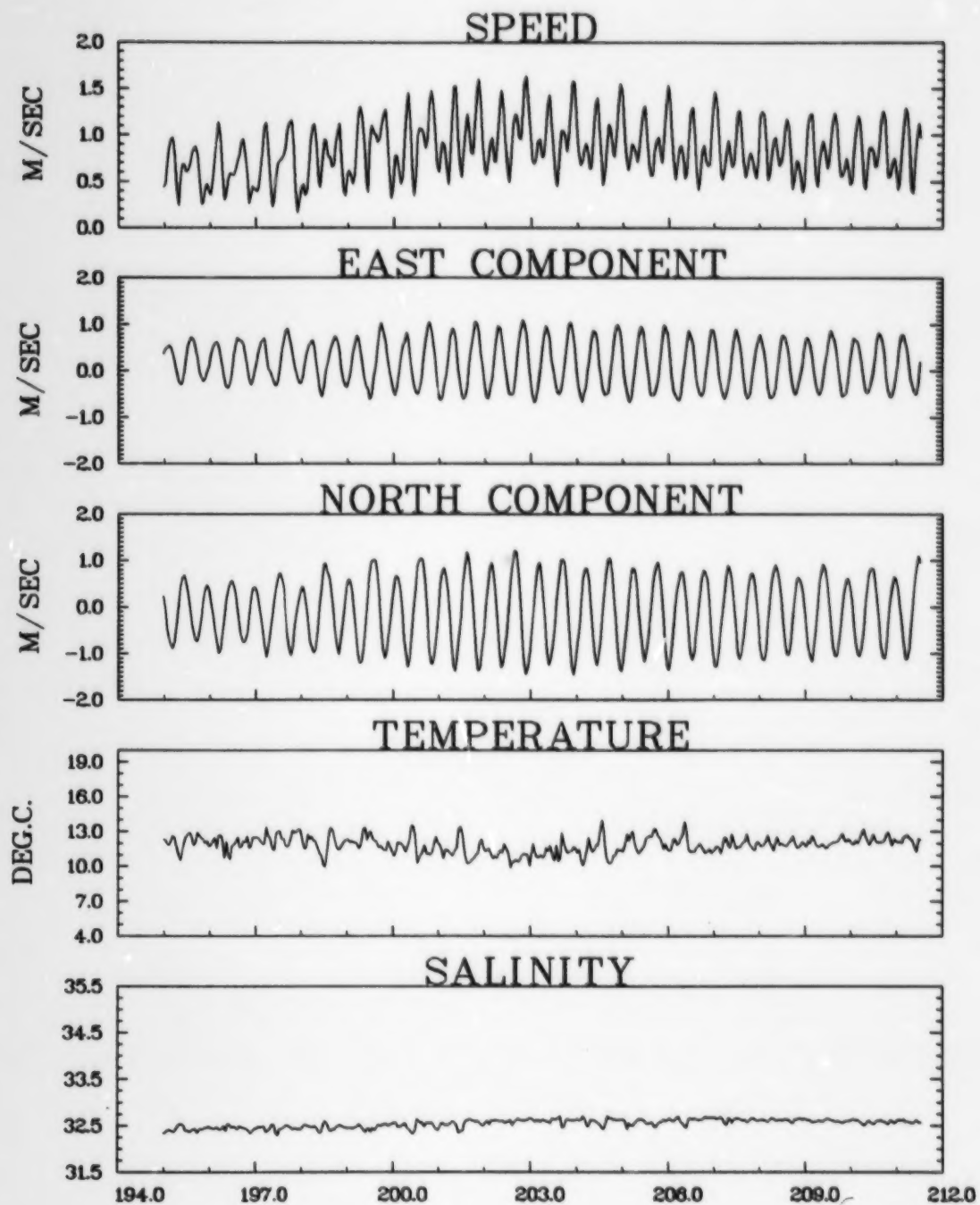
N	398
$\bar{X}$	32.55
Σ_1	0.09
Σ_6	0.06

Sigma-theta (kg.m^{-3})

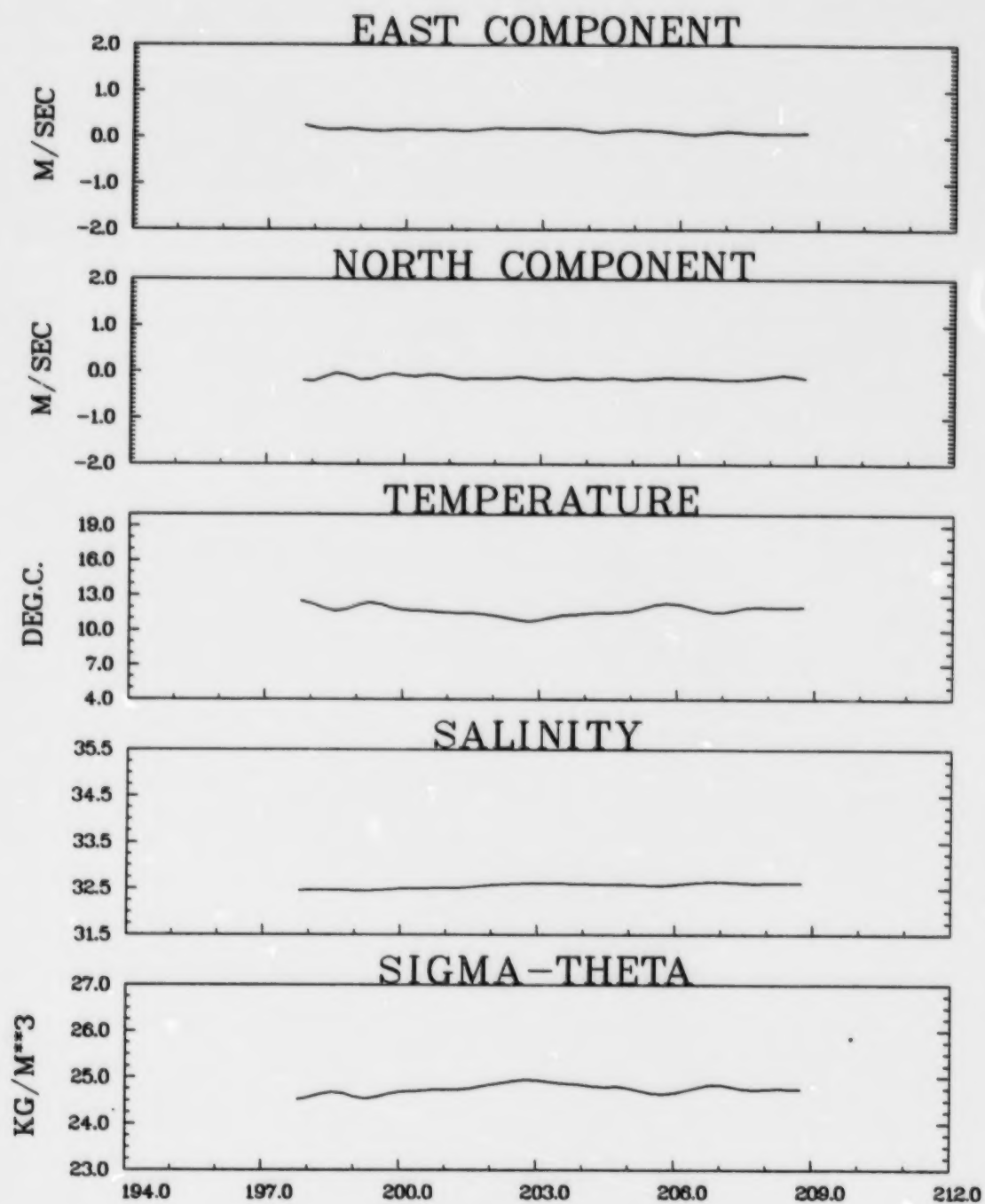
N	398
$\bar{X}$	24.71
Σ_1	0.18
Σ_6	0.11

N: number of samples in statistics

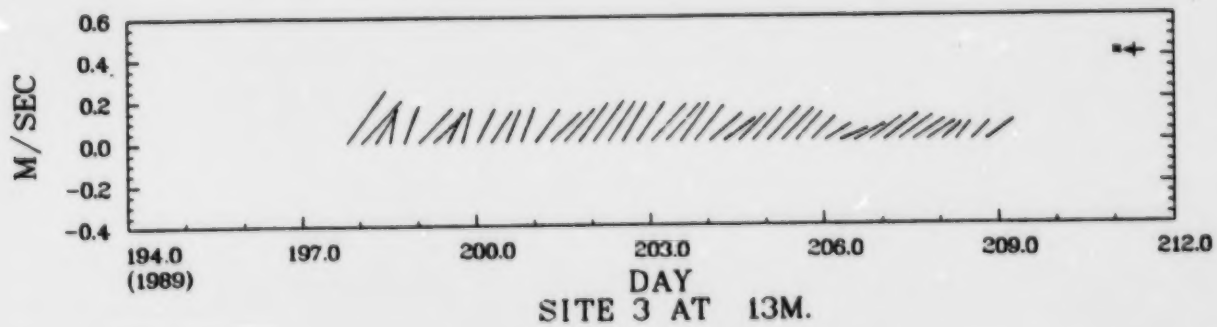
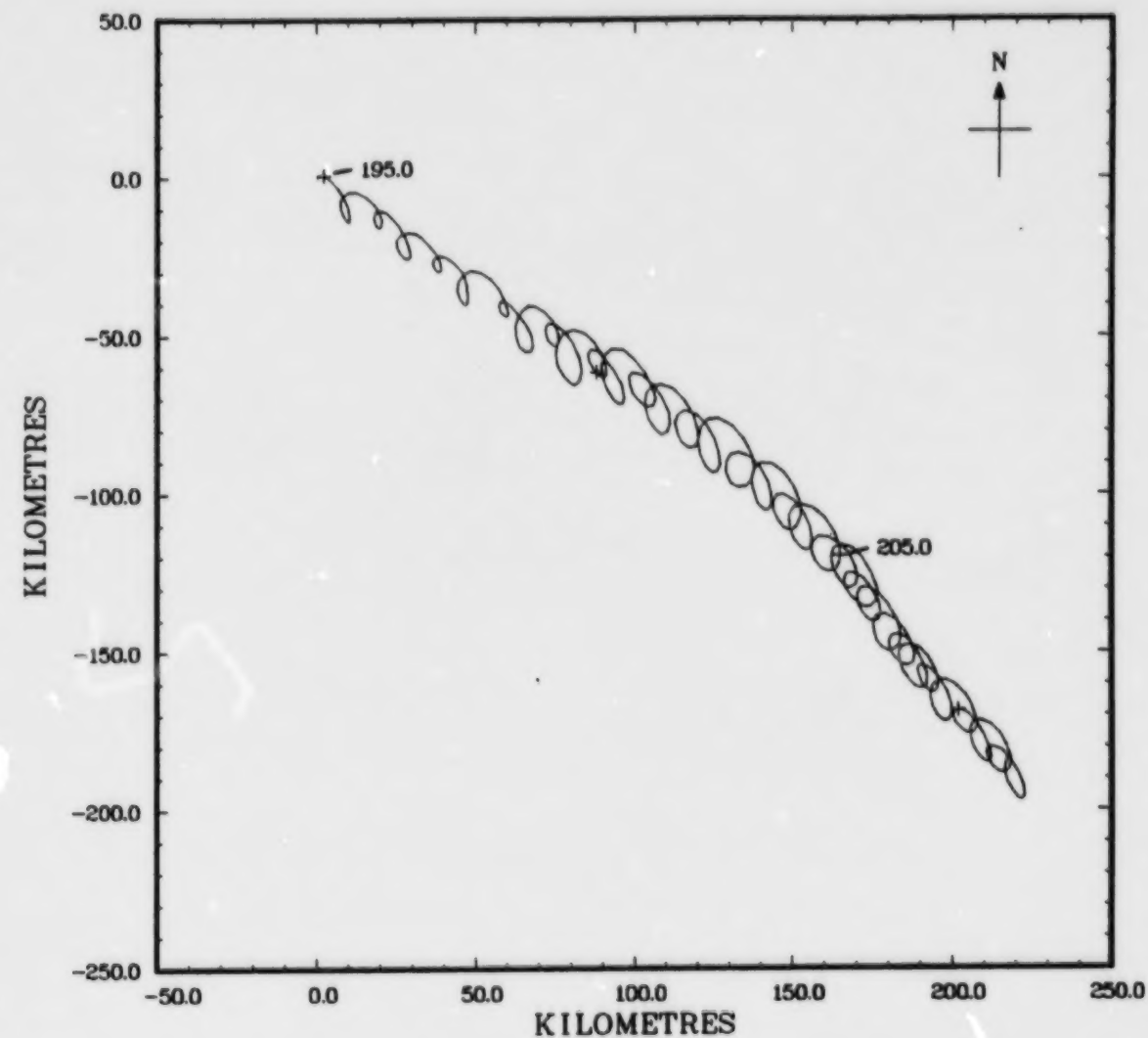
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 13 M.



SITE 3 AT 13 M.



STATISTICS

Site 3 at 36 m, 1989

(Mooring 955)

RECORD/JULY

East Velocity Component (m.s^{-1})

N	398
$\bar{X}$	0.128
Σ_1	0.403
Σ_6	0.022

North Velocity Component (m.s^{-1})

N	398
$\bar{X}$	-0.110
Σ_1	0.651
Σ_6	0.028

Temperature ($^{\circ}\text{C}$)

N	398
$\bar{X}$	10.12
Σ_1	0.94
Σ_6	0.64

Salinity (PSS78)

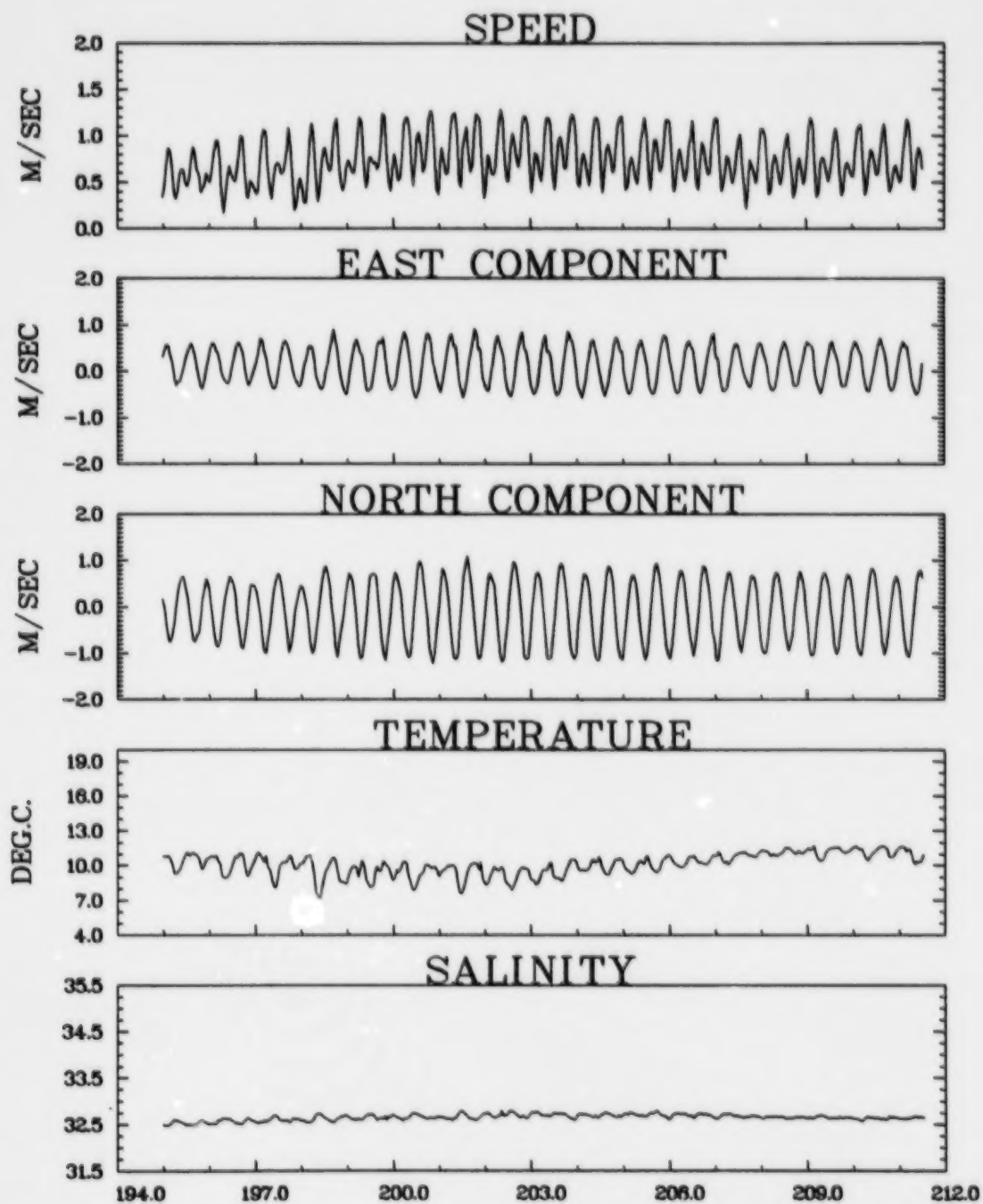
N	398
$\bar{X}$	32.65
Σ_1	0.06
Σ_6	0.03

Sigma-theta (kg.m^{-3})

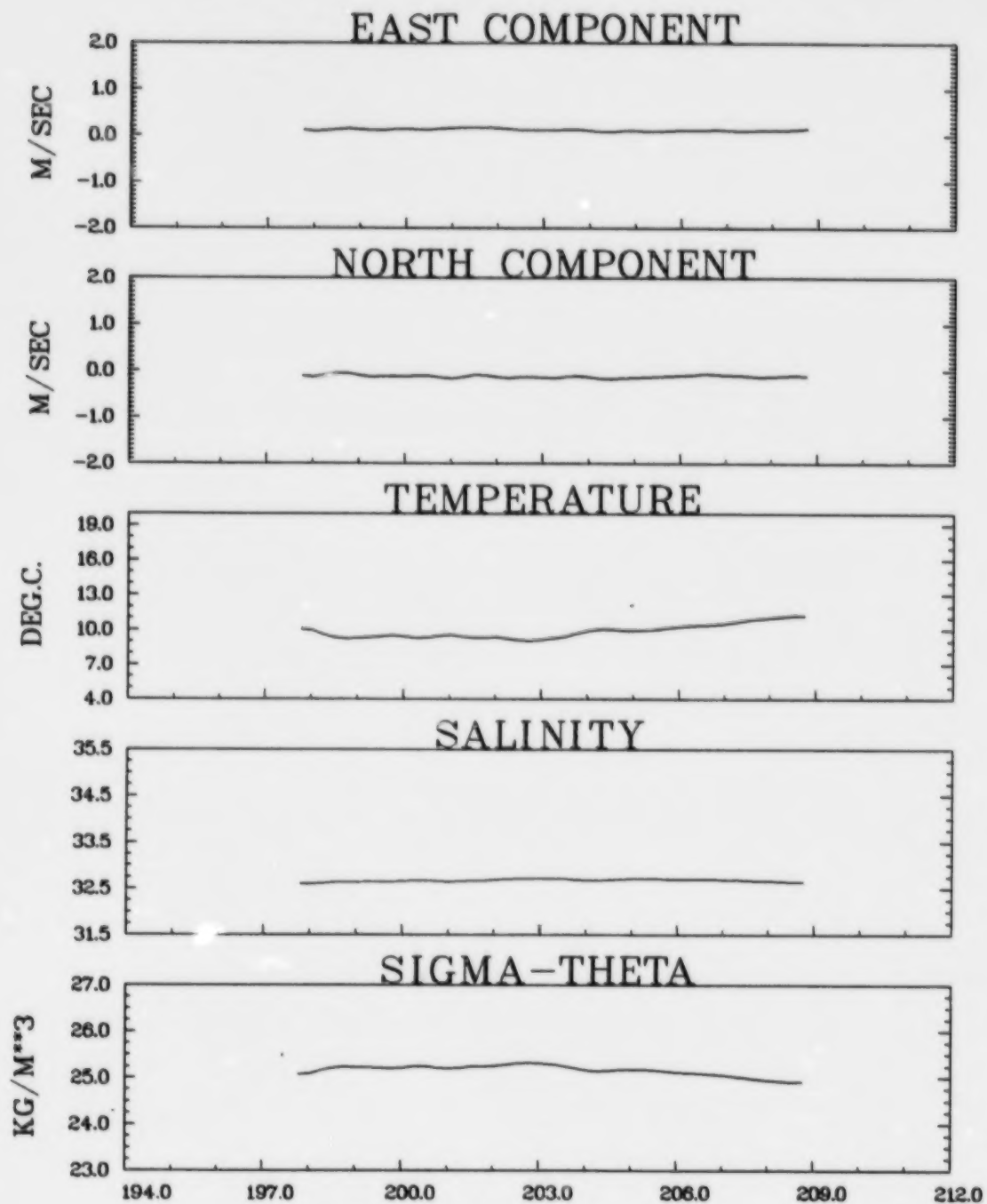
N	398
$\bar{X}$	25.10
Σ_1	0.18
Σ_6	0.11

N: number of samples in statistics

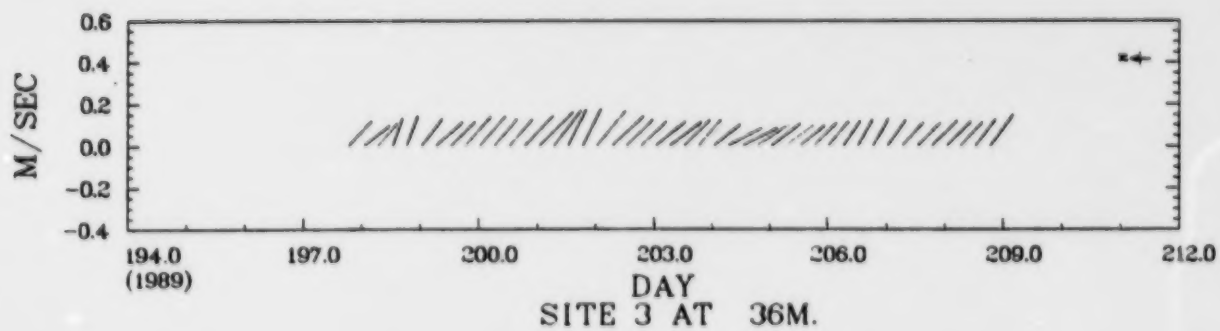
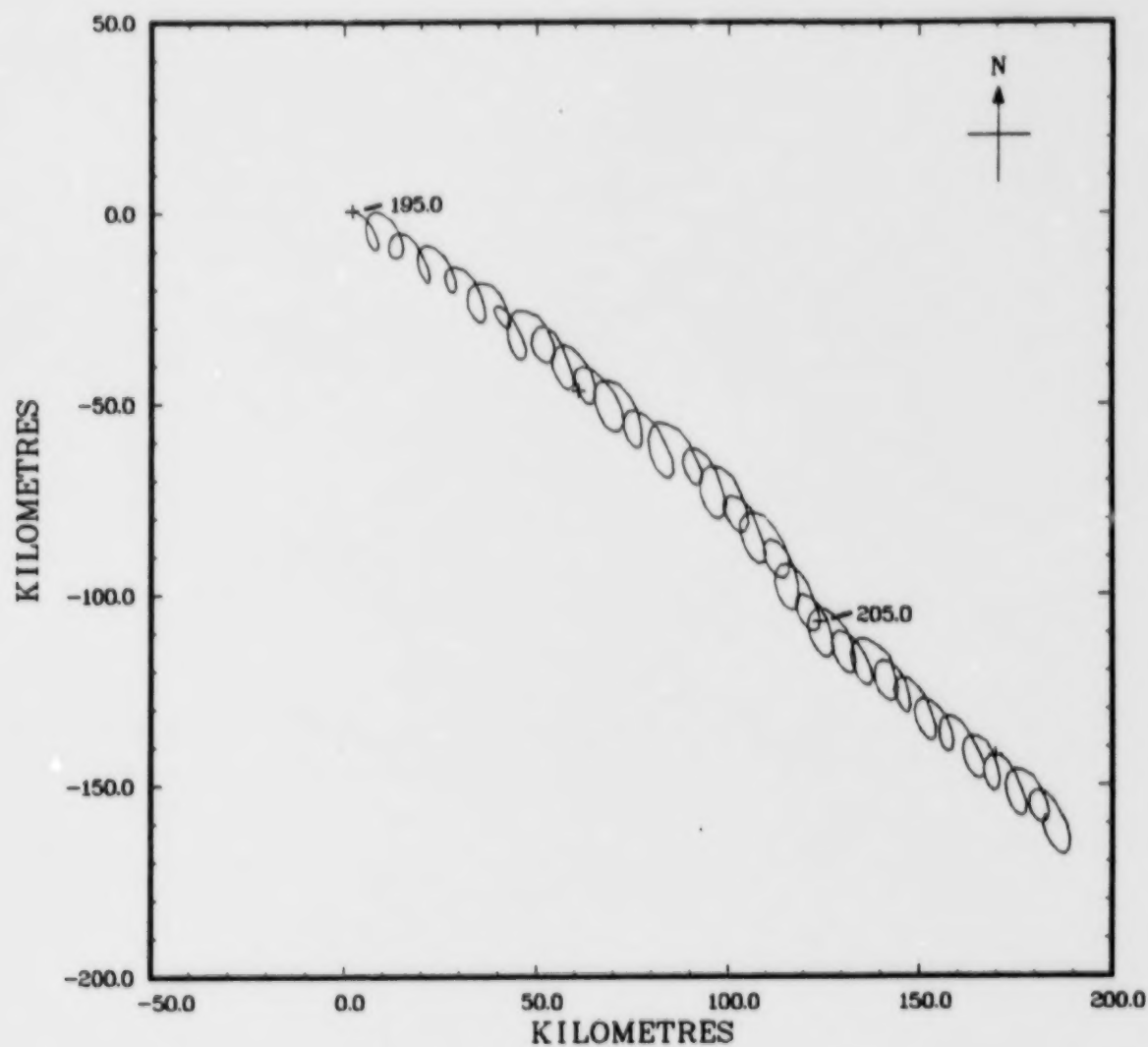
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 36 M.



SITE 3 AT 36 M.



STATISTICS

Site 3 at 60 m, 1989

(Mooring 955)

RECORD/JULY

East Velocity Component (m.s^{-1})

N	398
$\bar{X}$	0.034
Σ_1	0.267
Σ_6	0.021

North Velocity Component (m.s^{-1})

N	398
$\bar{X}$	-0.048
Σ_1	0.442
Σ_6	0.039

Temperature ($^{\circ}\text{C}$)

N	398
$\bar{X}$	9.60
Σ_1	1.04
Σ_6	0.86

Salinity (PSS78)

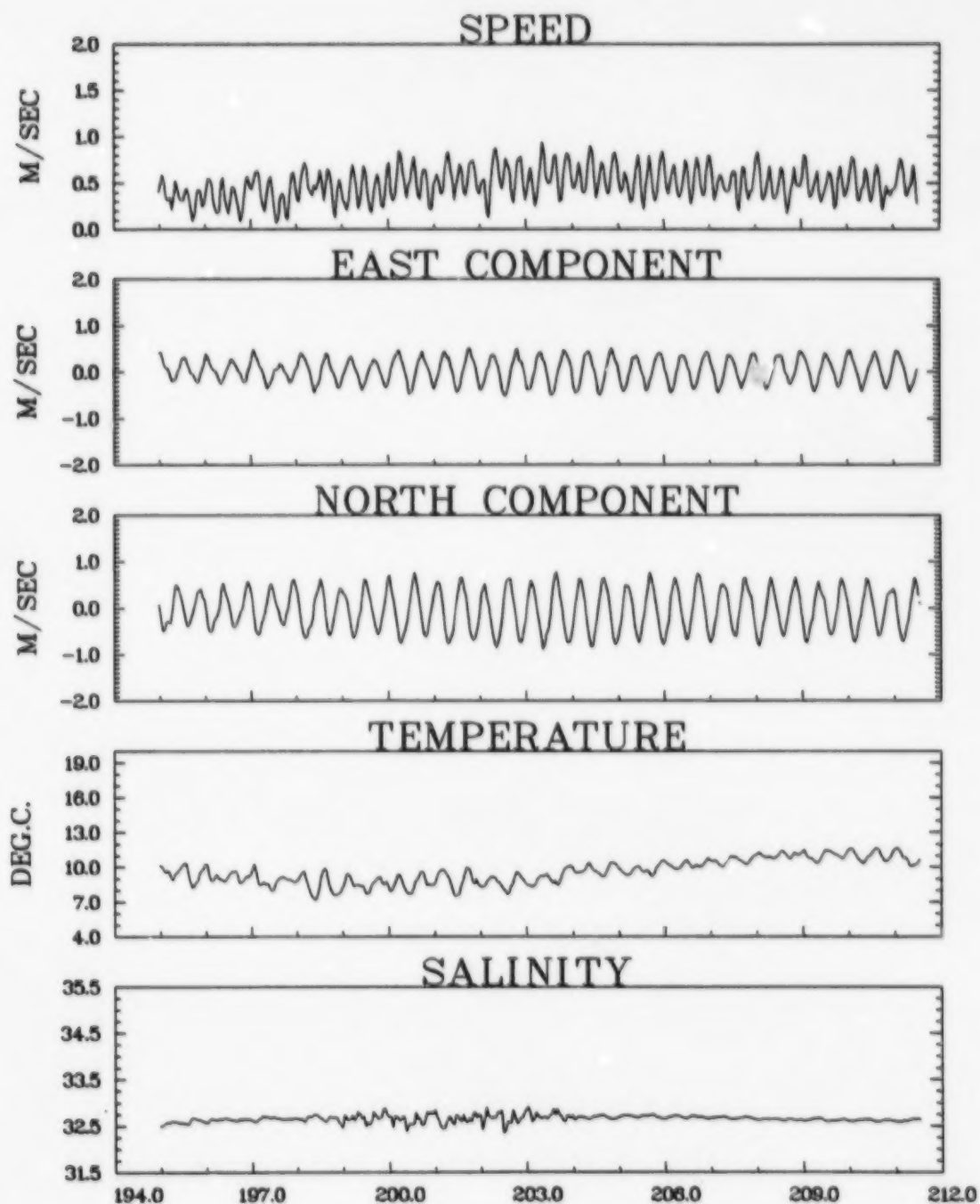
N	398
$\bar{X}$	32.66
Σ_1	0.07
Σ_6	0.03

Sigma-theta (kg.m^{-3})

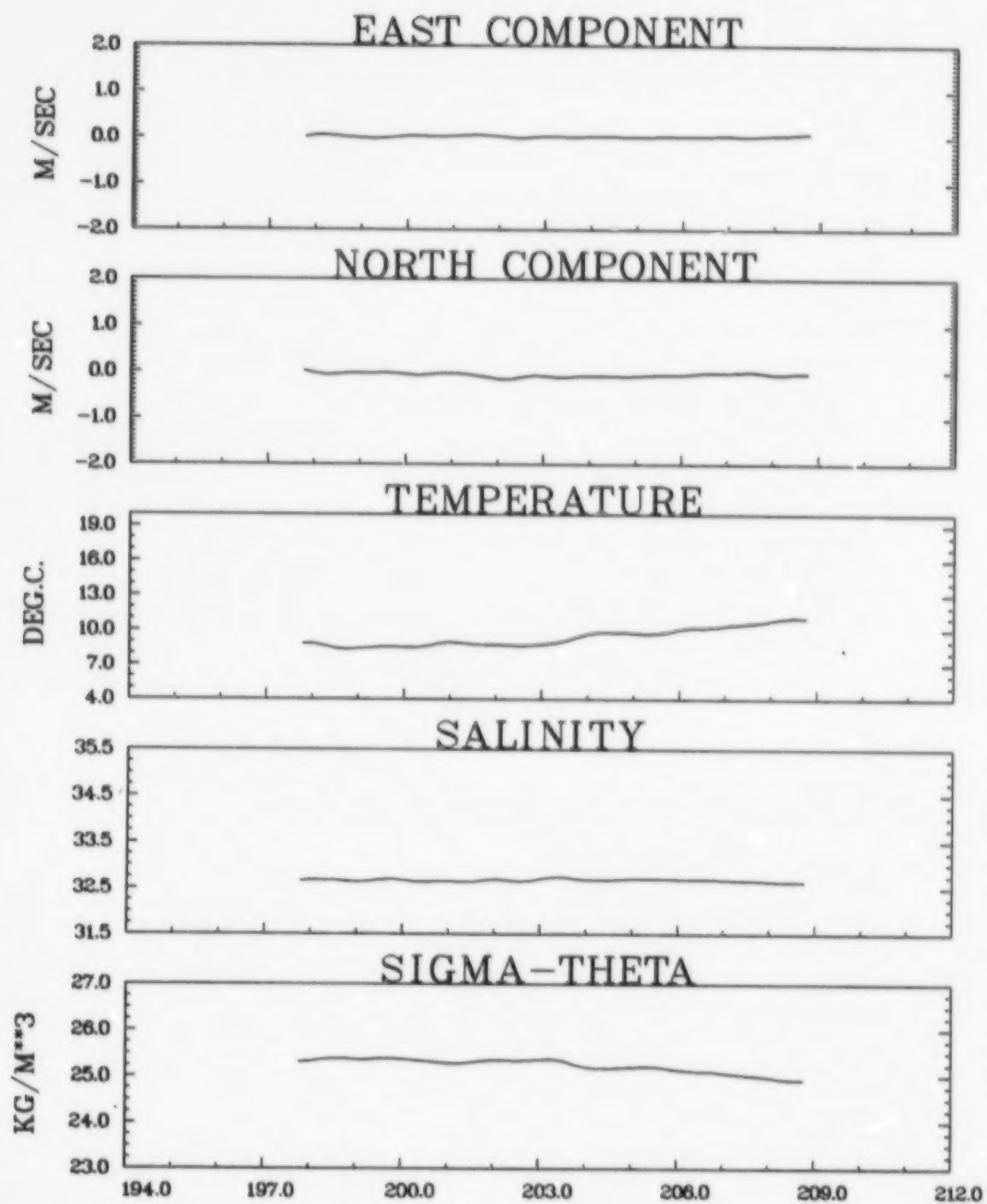
N	398
$\bar{X}$	25.18
Σ_1	0.19
Σ_6	0.14

N: number of samples in statistics

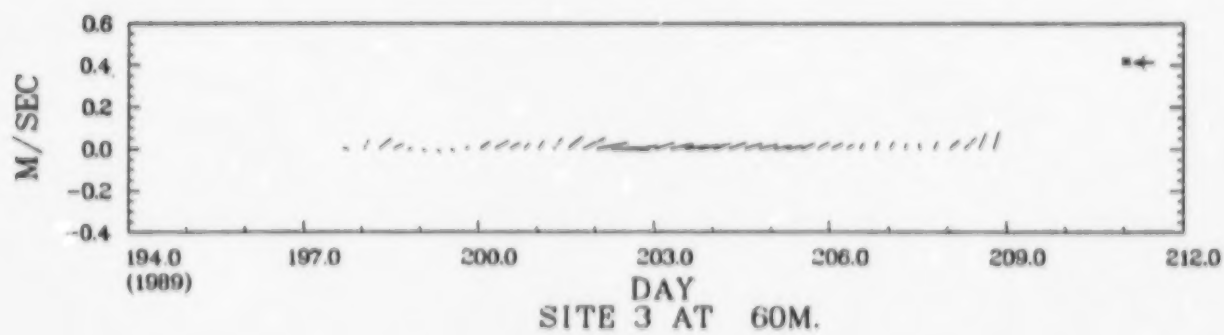
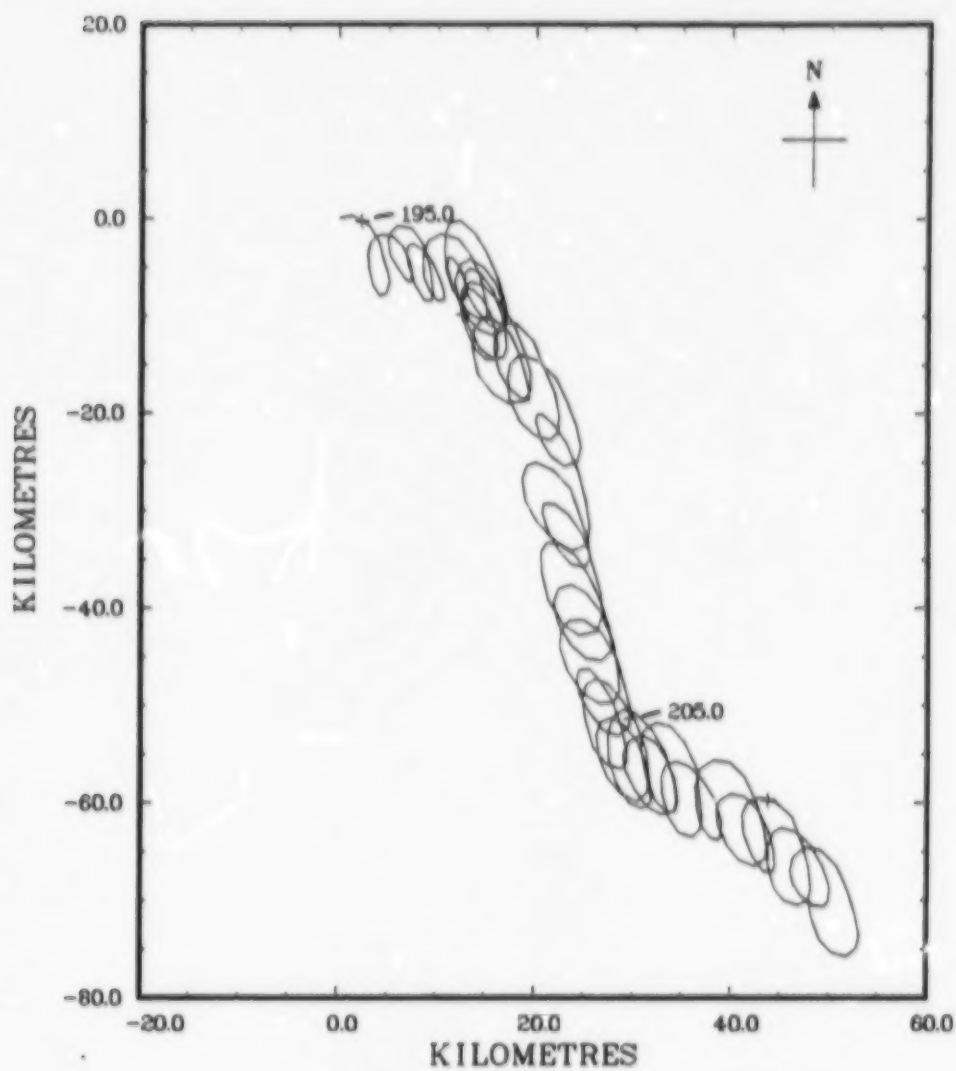
 $\bar{X}$: mean value Σ_1 : standard deviation of 1-hr time series Σ_6 : standard deviation of 6-hr time series



SITE 3 AT 60 M.



SITE 3 AT 60 M.



TIDAL ANALYSIS RESULTS

BY SITE AND POSITION

THERE IS A PAGE FOR EACH SITE (S1, S2, ETC.)

WITH A TABLE FOR EACH POSITION WITH VELOCITY DATA.

SITE (MOORING) (DEPTH)	CONSTITUENT	110.0 DAYS CENTERED AT DAY 233, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG. T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S1 (889,021M)	K1	.048	.026	19	39/C	.029	98	.046	29
	O1	.024	.003	61	334/A	.021	330	.012	346
	M2	.605	.291	118	186/C	.552	172	.382	48
	S2	.071	.039	126	208/C	.062	186	.053	64
	N2	.151	.078	120	153/C	.137	136	.102	14
	MF	.015	.000	45	226/A	.010	226	.010	226
	M4	.021	.000	32	195/C	.011	195	.018	194
	MS4	.010	.002	24	216/C	.004	235	.009	212

110.0 DAYS CENTERED AT DAY 233, 1988									
S1 (889,043M)	K1	.028	.004	22	60/C	.011	78	.026	57
	O1	.016	.003	317	90/A	.011	280	.012	82
	M2	.617	.326	123	188/C	.547	169	.434	47
	S2	.073	.036	126	212/C	.063	193	.052	67
	N2	.135	.066	120	149/C	.122	133	.089	9
	MF	.017	.005	53	208/C	.014	220	.011	187
	M4	.060	.019	26	233/C	.031	266	.054	224
	MS4	.012	.003	60	239/C	.011	248	.007	215

14.6 DAYS CENTERED AT DAY 185, 1988									
S1 (889,090M)	K1	.027	.013	33	7/A	.018	332	.024	24
	O1	.025	.010	21	15/A	.013	330	.024	23
	M2	.511	.226	326	348/C	.339	134	.444	4
	S2	.041	.001	330	4/C	.021	183	.036	4
	N2	.107	.049	321	350/C	.078	141	.089	11
	MF	.019	.012	69	356/A	.018	343	.013	54
	M4	.041	.028	67	159/C	.039	176	.030	101
	MS4	.023	.001	20	131/C	.008	138	.022	130

110.0 DAYS CENTERED AT DAY 233, 1988									
S1 (889,145M)	K1	.039	.013	66	313/A	.037	305	.020	351
	O1	.030	.005	74	307/A	.029	304	.009	337
	M2	.266	.073	319	357/A	.183	195	.206	344
	S2	.036	.016	329	21/A	.023	238	.032	5
	N2	.069	.017	335	321/A	.033	168	.063	314
	MF	.018	.003	70	344/A	.017	341	.007	9
	M4	.083	.029	327	294/C	.051	85	.072	307
	MS4	.025	.009	343	337/C	.011	107	.024	343

SITE (MOORING) (DEPTH)	CONSTITUENT	62.5 DAYS CENTERED AT DAY 211, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S2 (891,010M)	K1	.106	.041	8	32/C	.043	103	.105	29
	O1	.043	.016	19	334/C	.021	20	.041	327
	M2	.920	.404	331	20/C	.565	161	.830	33
	S2	.146	.049	333	65/C	.079	212	.132	75
	N2	.249	.091	337	9/C	.130	148	.231	18
	MF	.016	.007	13	136/A	.007	75	.016	141
	M4	.040	.027	340	171/C	.028	290	.038	185
	MS4	.011	.001	53	254/C	.009	256	.007	250

109.9 DAYS CENTERED AT DAY 234, 1988									
S2 (891,034M)	K1	.059	.007	355	44/C	.009	173	.059	44
	O1	.027	.008	354	19/A	.008	269	.027	17
	M2	.943	.414	330	10/C	.590	152	.844	24
	S2	.126	.045	326	32/C	.080	184	.108	45
	N2	.222	.085	328	342/C	.138	131	.193	356
	MF	.018	.004	357	11/C	.004	113	.018	11
	M4	.045	.001	111	304/A	.042	305	.016	121
	MS4	.014	.001	101	24/A	.013	25	.003	179

109.9 DAYS CENTERED AT DAY 234, 1988									
S2 (891,057M)	K1	.060	.011	354	41/C	.013	160	.060	42
	O1	.036	.009	342	29/A	.014	247	.034	24
	M2	.722	.236	331	358/C	.403	147	.644	8
	S2	.090	.019	337	26/C	.040	180	.083	31
	N2	.183	.047	338	330/C	.081	117	.171	336
	MF	.007	.001	322	196/C	.004	8	.005	201
	M4	.053	.031	330	254/C	.037	29	.049	272
	MS4	.015	.006	319	290/C	.011	85	.012	308

110.0 DAYS CENTERED AT DAY 234, 1988									
S2 (891,064M)	K1	.047	.004	353	49/C	.007	193	.046	49
	O1	.024	.008	335	34/A	.013	252	.022	25
	M2	.482	.144	330	358/C	.271	151	.424	8
	S2	.062	.015	334	25/C	.030	178	.056	32
	N2	.120	.033	334	333/C	.061	123	.109	340
	MF	.006	.001	87	360/C	.006	1	.001	285
	M4	.060	.031	336	296/C	.038	68	.056	309
	MS4	.014	.009	317	330/C	.011	115	.012	1

SITE (MOORING) (DEPTH)	CONSTITUENT	16.0 DAYS CENTERED AT DAY 185, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S3 (893,011M)	K1	.072	.027	14	37/C	.032	94	.070	32
	O1	.042	.007	10	7/A	.010	325	.041	9
	M2	1.027	.524	335	22/C	.640	153	.960	35
	S2	.183	.108	339	50/C	.121	173	.175	63
	N2	.277	.134	337	359/C	.164	131	.260	11
	MF	.009	.001	9	202/C	.002	240	.009	201
	M4	.038	.006	350	206/C	.009	342	.038	207
	MS4	.021	.003	346	204/C	.006	355	.021	206

111.8 DAYS CENTERED AT DAY 233, 1988									
S3 (893,034M)	K1	.072	.027	4	35/C	.027	114	.072	34
	O1	.030	.001	357	3/A	.002	218	.030	3
	M2	.895	.439	334	15/C	.560	150	.825	29
	S2	.113	.047	331	33/C	.068	176	.102	46
	N2	.213	.094	333	342/C	.128	121	.194	355
	MF	.010	.001	133	101/A	.007	104	.007	278
	M4	.023	.001	133	64/C	.017	62	.016	247
	MS4	.005	.001	117	87/C	.004	80	.002	290

19.8 DAYS CENTERED AT DAY 187, 1988									
S3 (893,057M)	K1	.068	.027	358	57/C	.027	151	.068	58
	O1	.015	.001	356	344/C	.001	132	.015	344
	M2	.664	.310	338	3/C	.380	134	.626	14
	S2	.090	.054	337	57/C	.061	182	.086	71
	N2	.164	.081	334	351/C	.103	126	.151	5
	MF	.019	.000	6	104/C	.002	116	.019	104
	M4	.018	.012	32	189/A	.014	144	.017	211
	MS4	.012	.008	73	100/C	.012	111	.008	35

111.8 DAYS CENTERED AT DAY 233, 1988									
S3 (893,064M)	K1	.049	.022	356	62/C	.022	160	.049	63
	O1	.012	.003	129	222/C	.010	212	.008	59
	M2	.488	.185	332	357/C	.281	142	.440	9
	S2	.076	.034	333	37/C	.046	177	.069	51
	N2	.131	.061	333	340/C	.081	119	.120	354
	MF	.008	.005	25	140/A	.006	89	.008	155
	M4	.021	.011	66	141/C	.020	154	.013	92
	MS4	.005	.002	338	343/C	.003	121	.005	351

SITE (MOORING) (DEPTH)	CONSTITUENT	108.8 DAYS CENTERED AT DAY 234, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S4 (895,010M)	K1	.098	.043	21	66/C	.054	115	.093	57
	O1	.032	.004	10	32/C	.007	65	.032	30
	M2	.860	.626	331	23/C	.690	151	.810	46
	S2	.121	.095	343	54/C	.098	165	.119	67
	N2	.214	.167	349	7/C	.169	111	.213	15
	MF	.014	.004	328	211/C	.008	8	.012	221
	M4	.043	.004	97	261/A	.043	261	.007	46
	MS4	.018	.003	118	274/A	.016	279	.009	78

108.8 DAYS CENTERED AT DAY 234, 1988									
S4 (895,034M)	K1	.079	.025	22	64/C	.038	102	.074	56
	O1	.031	.002	5	26/C	.003	55	.031	25
	M2	.821	.526	336	14/C	.587	140	.778	31
	S2	.106	.068	336	37/C	.075	161	.101	52
	N2	.184	.124	341	351/C	.131	108	.178	4
	MF	.013	.003	336	215/C	.006	4	.012	221
	M4	.021	.019	134	228/A	.020	268	.020	5
	MS4	.011	.002	95	296/A	.011	297	.002	57

108.8 DAYS CENTERED AT DAY 234, 1988									
S4 (895,053M)	K1	.062	.018	15	61/C	.024	108	.060	57
	O1	.022	.002	8	23/C	.004	59	.022	23
	M2	.697	.441	338	7/C	.484	130	.667	21
	S2	.086	.054	333	41/C	.062	169	.081	58
	N2	.164	.112	347	351/C	.115	100	.162	0
	MF	.011	.005	351	178/A	.005	69	.011	174
	M4	.021	.001	71	289/C	.020	290	.007	281
	MS4	.008	.001	80	330/A	.008	329	.002	1

SITE (MOORING) (DEPTH)	CONSTITUENT	12.2 DAYS CENTERED AT DAY 185, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S5 (896,039M)	K1	.057	.022	2	60/C	.022	144	.057	59
	O1	.031	.014	132	253/A	.025	275	.024	47
	M2	.770	.322	122	186/C	.674	172	.492	40
	S2	.081	.038	118	223/C	.073	208	.051	84
	N2	.168	.117	333	18/C	.129	143	.159	37
	MF	.011	.002	356	138/A	.002	23	.011	137
	M4	.053	.012	63	234/A	.047	227	.026	258
	MS4	.015	.001	107	203/C	.015	201	.005	36

12.2 DAYS CENTERED AT DAY 185, 1988									
S5 (896,071M)	K1	.045	.012	336	72/C	.022	220	.042	79
	O1	.039	.003	340	66/A	.014	257	.036	65
	M2	.648	.307	123	174/C	.570	157	.436	30
	S2	.083	.033	329	30/C	.051	176	.074	43
	N2	.109	.064	316	356/C	.089	145	.090	26
	MF	.021	.002	71	245/A	.019	243	.007	258
	M4	.073	.011	47	225/C	.053	233	.050	216
	MS4	.023	.003	334	305/C	.010	112	.021	308

12.2 DAYS CENTERED AT DAY 185, 1988									
S5 (896,102M)	K1	.042	.015	328	76/A	.026	284	.036	63
	O1	.029	.021	80	288/A	.029	281	.021	4
	M2	.576	.198	319	343/C	.406	142	.454	0
	S2	.100	.057	326	43/C	.073	183	.089	64
	N2	.117	.037	322	4/C	.078	162	.095	18
	MF	.022	.001	94	247/C	.021	247	.002	95
	M4	.065	.018	105	188/C	.063	184	.025	55
	MS4	.014	.004	68	48/C	.013	54	.007	12

12.2 DAYS CENTERED AT DAY 185, 1988									
S5 (896,138M)	K1	.046	.032	121	283/A	.043	305	.036	54
	O1	.064	.005	86	273/A	.064	272	.007	318
	M2	.337	.042	340	322/A	.123	160	.316	319
	S2	.044	.009	128	180/C	.035	170	.028	15
	N2	.087	.007	321	7/C	.055	182	.068	11
	MF	.028	.001	94	290/C	.027	290	.002	126
	M4	.097	.077	321	259/C	.086	35	.090	292
	MS4	.016	.001	118	326/C	.014	325	.007	150

SITE (MOORING) (DEPTH)	CONSTITUENT	12.3 DAYS CENTERED AT DAY 185, 1988							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S6 (897,009M)	K1	.110	.042	16	59/C	.051	111	.107	52
	O1	.068	.004	348	30/A	.014	224	.067	30
	M2	.789	.447	325	22/C	.584	163	.693	44
	S2	.137	.053	341	81/C	.067	212	.131	88
	N2	.238	.128	330	19/C	.162	155	.217	36
	MF	.036	.016	90	80/A	.036	80	.016	171
	M4	.036	.025	13	310/C	.025	22	.035	301
	MS4	.012	.006	50	211/A	.010	188	.009	242

12.3 DAYS CENTERED AT DAY 185, 1988									
S6 (897,041M)	K1	.056	.034	18	88/C	.037	150	.054	77
	O1	.027	.002	1	14/C	.002	91	.027	14
	M2	.841	.433	333	11/C	.541	145	.777	25
	S2	.124	.066	334	14/C	.080	146	.115	28
	N2	.164	.101	341	1/C	.110	120	.159	13
	MF	.025	.017	346	327/C	.017	77	.024	336
	M4	.051	.012	87	273/C	.051	273	.013	193
	MS4	.029	.011	100	222/C	.028	219	.012	108

12.3 DAYS CENTERED AT DAY 185, 1988									
S6 (897,073M)	K1	.061	.015	349	88/C	.019	215	.060	91
	O1	.015	.000	125	238/C	.012	238	.008	58
	M2	.510	.288	336	349/C	.336	117	.479	3
	S2	.072	.027	346	32/C	.031	156	.070	37
	N2	.142	.031	338	355/C	.060	147	.132	360
	MF	.014	.002	74	311/A	.014	309	.004	335
	M4	.023	.011	117	233/C	.021	219	.014	97
	MS4	.010	.004	97	249/C	.010	247	.004	142

SITE (MOORING) (DEPTH)	CONSTITUENT	16.6 DAYS CENTERED AT DAY 203, 1989							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
S3 (955,013M)	K1	.111	.047	11	46/C	.051	113	.110	42
	O1	.051	.011	18	0/C	.019	34	.049	356
	M2	1.065	.512	332	24/C	.671	161	.973	38
	S2	.196	.108	331	55/C	.134	190	.179	72
	N2	.181	.105	321	339/C	.140	123	.156	4
	MF	.024	.002	71	249/A	.023	247	.008	262
	M4	.042	.025	8	215/C	.025	291	.041	210
	MS4	.036	.006	337	255/C	.015	54	.033	258

16.6 DAYS CENTERED AT DAY 203, 1989									
S3 (955,036M)	K1	.063	.031	348	41/C	.033	155	.062	47
	O1	.036	.002	11	347/A	.007	330	.035	347
	M2	.964	.448	337	14/C	.558	147	.905	26
	S2	.179	.084	336	36/C	.107	170	.166	48
	N2	.139	.047	338	337/C	.067	116	.131	344
	MF	.013	.009	5	141/C	.009	223	.013	137
	M4	.045	.009	360	239/A	.009	147	.045	239
	MS4	.013	.007	50	269/C	.011	295	.010	234

16.6 DAYS CENTERED AT DAY 203, 1989									
S3 (955,060M)	K1	.059	.033	352	80/C	.034	185	.059	85
	O1	.020	.010	320	52/C	.015	201	.016	75
	M2	.617	.263	335	359/C	.351	138	.571	10
	S2	.080	.025	326	43/C	.049	198	.068	55
	N2	.127	.053	342	354/C	.064	122	.122	2
	MF	.027	.005	26	152/A	.013	131	.025	157
	M4	.033	.008	89	125/C	.033	125	.008	41
	MS4	.017	.015	7	48/C	.015	130	.017	42